

# SHRI GURU RAM RAI UNIVERSITY

[Estd. by Govt. of Uttarakhand, vide Shri Guru Ram Rai University Act no. 03 of 2017 & recognized  
by UGC u/s (2f) of UGC Act 1956]

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**SYLLABUS FOR**

**B.Sc Geology**

**School of Basic & Applied Sciences**

**(w.e.f. 2021-2022)**

**SHRI GURU RAM RAI UNIVERSITY, PATEL NAGAR, DEHRADUN  
UTTARAKHAND-248001**

## OUTCOME BASED EDUCATION

### Programme outcome (POs)

<b>PO 1</b>	Bachelor of Science offers theoretical as well as practical knowledge about different subject areas.
<b>PO2</b>	Graduates will develop scientific temperament to solve scientific problems in emerging areas of science at National and International level.
<b>PO3</b>	Graduates will acquire coherent understanding of the academic field to pursue multi and interdisciplinary science careers in future.
<b>PO4</b>	Graduate will have clarity of thought and expression. Qualities like logical thinking and decision making will be enhanced
<b>PO5</b>	Graduates plan and execute experiments or investigations, analyze and interpret data information collected using appropriate methods
<b>PO6</b>	Graduates will be able to compete in various national and international competitive examinations.
<b>PO7</b>	Graduates will understand the principles of basic and applied sciences and apply them logically in environmental and socio-technological context with a systematic approach towards sustainable development.
<b>PO8</b>	Graduates will have critical thinking, follow innovations and developments in Science and technology.
<b>PO9</b>	Graduates will acquire effective communication skills
<b>PO10</b>	Graduates will understand ethical principles and responsibilities for effective citizenship.
<b>PO11</b>	Graduates will develop new and enhancing conversational skills that lead to not only to good communication but also to the excellent drafting abilities linked with technical reports and presentations.
<b>PO12</b>	Graduates will competent enough for doing jobs in Govt. and private sectors of academia, research and industry.

### Program Specific Outcome (PSOs)

On successful completion of the B Sc. Geology program students will be able to

<b>PSO1</b>	Acquire a knowledge in the Science of geology as a whole as well as Earth materials, Petrology, Geochemistry, Mineralogy, Hydrology, Natural disaster and Stratigraphy, Structural features, and geomorphic processes and landforms.
<b>PSO2</b>	Apply principles of mathematics, chemistry, and physics to geologic problems
<b>PSO3</b>	Use compasses, survey instruments, and satellite images in geological investigations

<b>PSO4</b>	Develop intellectual ability and geological skills through an appropriate blending of theoretical subject education, practical exercises and field training
<b>PSO5</b>	Attain basic knowledge, training, skills and eligibility degree for various higher academic courses and position in Govt. and private sector.

### Eligibility for admission:

Any candidate who has passed the Plus Two of the Higher Secondary Board of Examinations in any state recognized as equivalent to the Plus Two of the Higher Secondary Board in with not less than 45 %-marks in aggregate is eligible for admission, However, SC/ST, OBC and other eligible communities shall be given relaxation as per University rules.

### Duration of the Programme : 3 years

## STUDY & EVALUATION SCHEME

### Choice Based Credit System

### B.Sc. Geology

#### First Semester

S. No.	Course Category	Course Code	Course Name	Periods				Evaluation scheme		Subject Total
				L	T	P	C	Sessional (Internal)	External (ESE)	
Theory										
1	Core	BGLC101	Physical Geology and Structural Geology	4	0	0	4	30	70	100
2	Elective	AECC101	Environmental Science	4	0	0	4	30	70	100
Practical										
1	Lab Course		BGLL101	0	0	4	2	30	70	100

L – Lecture, T – Tutorial, P – Practical, C – Credit

#### Second Semester

S. No.	Course Category	Course Code	Course Name	Periods				Evaluation scheme		Subject Total
				L	T	P	C	Sessional (Internal)	External (ESE)	
Theory										
1	Core	BGLC201	Mineralogy and Crystallography	4	0	0	4	30	70	100

2	Elective	AECC202	English Communication	4	0	0	4	30	70	100
Practical										
1	Lab Course	BGLL201	Lab course based on C201	0	0	4	2	30	70	100

L – Lecture, T – Tutorial, P – Practical, C – Credit

### Third Semester

S. No.	Course Category	Course Code	Course Name	Periods				Evaluation scheme		Subject Total
				L	T	P	C	Sessional (Internal)	External (ESE)	
Theory										
1	Core	BGLC301	Petrology	4	0	0	4	30	70	100
2	Skill Enhancement	BGLS302	Geomorphology and Geotectonics	4	0	0	4	30	70	100
3										
Practical										
1	Lab Course	BGLL301	Lab course based on C301	0	0	4	2	30	70	100
2										

L – Lecture, T – Tutorial, P – Practical, C – Credit

### Fourth Semester

S. No.	Course Category	Course Code	Course Name	Periods				Evaluation scheme		Subject Total
				L	T	P	C	Sessional (Internal)	External (ESE)	
Theory										
1	Core	BGLC401	Stratigraphy Principles and Indian Stratigraphy	4	0	0	4	30	70	100
2	Skill Enhancement	BGLS402	Micropaleontology & Oceanography	4	0	0	4	30	70	100
Practical										
1	Lab Course	BGLL401	Lab Course Based on BGLC401	0	0	4	2	30	70	100

L – Lecture, T – Tutorial, P – Practical, C – Credit

## Fifth Semester

S. No.	Course Category	Course Code	Course Name	Periods				Evaluation scheme		Subject Total
				L	T	P	C	Sessional (Internal)	External (ESE)	
Theory										
1	Elective	BGLD501	Palaeontology	4	0	0	4	30	70	100
		OR								
		BGLD502	Element of Geochemistry							
2	Skill Enhancement	BGLS503	Field geology	4	0	0	4	30	70	100
Practical										
1	Lab Course	BGLL501	Lab Course Based on BGLD501	0	0	4	2	30	70	100
		BGLL502	Lab Course Based on BGLD502							

L – Lecture, T – Tutorial, P – Practical, C – Credit

## Sixth Semester

S. No.	Course Category	Course Code	Course Name	Periods				Evaluation scheme		Subject Total
				L	T	P	C	Sessional (Internal)	External (ESE)	
Theory										
1	Elective	BGLD601	Economic Geology and Hydrology	4	0	0	4	30	70	100
		BGLD602	Engineering and Disaster Management							
2	Skill Enhancement	BGLS603	Remote Sensing and GIS	4	0	0	4	30	70	100
Practical										
1	Lab Course	BGLL601	Lab Course Based on BGLD601	0	0	4	2	30	70	100
		BGLL602	Lab Course Based on BGLD602							

L – Lecture, T – Tutorial, P – Practical, C – Credit

### Examination Scheme:

Components	I <sup>st</sup> internal	II <sup>nd</sup> Internal	External (ESE)
Weightage(%)	15	15	70

## Programme Name: B.Sc. Geology

<b>Course code</b>	<b>: BGLC101</b>			
<b>Course Name</b>	<b>: Physical Geology and Structural Geology</b>			
<b>Semester /Year</b>	<b>: I<sup>st</sup></b>			
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

L - Lecture T – Tutorial P – Practical C – Credit

### **Course Objectives: The objectives of this course are**

1. This course gives an overall introduction to Geology from topics ranging from the formation of the solar system, internal structure of the earth and, natural hazards of Earthquake and Volcanoes.
2. To learn the concept of Structural geology, Concept of strike and dip, Dipping strata , Brunton compass, major types of fold structures,
3. The geometric and genetic classification of faults, understand the geological significance of joint, unconformity and salt dome

### **Course Contents**

#### **Physical Geology**

**Unit 1** Introduction to geology and its scope, Earth and solar system: origin, size, shape, mass, density and its atmosphere, hydrosphere and lithosphere. [No. of Hours: 07 ]

**Unit 2** A brief account of various theories regarding the origin and age of the earth; structure of earth and its composition. [No. of Hours: 07 ]

**Unit 3** Processes of weathering and erosion: factors, types and their effects, elementary idea of geomorphic processes. [No. of Hours: 07 ]

**Unit 4** Earthquakes: nature of seismic waves, their intensity and magnitude scale; Origin of earthquake and its type, Volcanoes: types, products and causes of volcanism, tsunami.

[No. of Hours: 08 ]

#### **Structural Geology**

**Unit 5** 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, elementary idea of shear and strain.

[No. of Hours:08]

**Unit 6** Elementary idea of types of deformation; Folds: nomenclature and types of folds.

[No. of Hours: 08 ]

**Unit 7** Faults: parts of a fault, geometrical and genetic classifications, normal, thrust and slip faults.

[No. of Hours: 08 ]

**Unit 8** Definition, kinds and significance of joints and unconformity and salt dome.

[No. of Hours: 07 ]

**Text Books:**

**TB1 : Mahapatra, G.B.,** 1994. A text book of Physical Geology. CBS Publishers.

**TB2: Holmes, A & P.L. Duff.**(1996). Principles of Physical Geology, 4th revised edition, ELBS, London

**Reference Books:**

**RB1 : Billings, M.P.,**1972.Structural Geology. Prentice Hall.

**RB2 : Gokhale, N.W.** (1995), Theory of Structural Geology, CBS, Delhi.

**Course outcomes (COs):**

**Upon successful completion of the course a student will be able to**

CO1	Learn and Gain Knowledge to the different component of earth and the evolution of solar system, Processes of weathering and erosion, earthquake, volcanoes. idea of dip, strike, bed, fold , fault and unconformity.
CO2	Develop understanding of about the structure of Earth, Origin of solar system, factors of weathering ,erosion, earthquake, volcanoes, elementary idea of stress and strain, fold, fault, unconformity and joints.
CO3	Illustrate the theories of earth, structures, solar system, earthquake, volcanoes, fold , fault, joints and unconformity.
CO4	Correlate various Hypothesis on Origin of Earth ,dip and strike, stress and strain, weathering and erosion.
CO5	Measure the dip and strike with the help of clinometer compass/brunton.
CO6	Write the concept of unconformity, normal, thrust and slip faults.

**CO-PO-PSO Mapping**

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	1	2	2	2	1	1	3	2	2	1	1	1	2	1
CO2	3	1	2	1	3	2	1	1	1	1	2	3	3	1	1	1
CO3	1	1	1	2	2	1	1	-	3	2	2	1	1	1	1	1
CO4	2	2	2	2	1	2	1	1	3	2	3	2	2	2	2	2
CO5	3	1	1	1	1	1	1	1	3	1	2	3	3	1	1	1
CO6	2	3	2	3	2	2	3	3	3	1	2	3	3	2	2	1

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

## Programme Name: B.SC. Geology

<b>Course code</b>	<b>:</b>	<b>BGLL101</b>				
<b>Course Name</b>	<b>:</b>	<b>Lab Course based on BGLC101</b>				
<b>Semester /Year</b>	<b>:</b>	<b>I</b>				
			<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
			<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

L - Lecture T – Tutorial P – Practical C – Credit

### Course Objectives : The objectives of this course are

1. To understand the geomorphological models and features.
2. The student is introduced to the basic knowledge relevant to geological maps
3. Practical exercises emphasize the use of compasses, Clinometer and Brunton.

### Content

- **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.

### Text Books:

**TB1** : Dr. Harish Kapasya, Publisher: Himanshu Publications.

### Course outcomes (COs):

**Upon successful completion of the course a student will be able to**

CO1	Gain knowledge about the geomorphological features.
CO2	Understand maps of geological significance.
CO3	Explain the concept of clinometers/Brunton compass
CO4	Differentiate different types of folds/faults from block models
CO5	Measure the dip and strike with the help of clinometer compass/brunton.
CO6	Preparation of cross section profile from a geological map.



## CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	2	2	2	2	1	1	3	2	3	3	2	2	3	2
CO2	3	2	2	2	2	2	1	1	3	3	3	3	2	3	2	2
CO3	2	2	2	2	2	2	1	1	3	2	3	3	2	2	2	2
CO4	2	2	2	2	2	2	1	1	3	2	3	3	2	2	2	2
CO5	3	1	1	1	1	1	1	1	3	1	2	3	3	1	1	1
CO6	2	3	2	3	2	2	3	3	3	1	2	3	3	2	2	1

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

## Programme Name: B.Sc. Geology

<b>Course code</b>	<b>: BGLC201</b>
<b>Course Name</b>	<b>: Mineralogy and Crystallography</b>
<b>Semester /Year</b>	<b>: II</b>
	<b>L T P C</b>
	<b>4 0 0 4</b>

L - Lecture T – Tutorial P – Practical C – Credit

### Course Objectives: The objective of this course are

1. The student is introduced to the different mineral groups emphasizing their properties for megascopic and thin section identification and their distribution in different earth materials.
2. Study Crystallography which is the foundation of mineralogy, inorganic chemistry and material science, To understand the classification of different crystal systems, twinning types and its different law
3. Class lectures and practical, involving the study of crystal models and minerals hand specimens and thin sections

### Course Contents

#### Mineralogy

**Unit 1** Common physical properties of minerals (form, colour, lusture, streak, cleavage, fracture, hardness, and specific gravity), Chemical composition and diagnostic physical properties of silica, feldspar, amphibole, pyroxene, olivine, feldspathoid, carbonatite.

[No. of Hours: 08 ]

**Unit 2** Classification of silicate structures, physical properties of non silicate.

[No. of Hours: 07]

**Unit 3** Polarizing microscope, its parts and functioning; Ordinary and polarized lights; Common optical properties observed under ordinary, polarized lights and crossed nicols.

**[No. of Hours: 08 ]**

**Unit 4** Optical properties of some common rock forming minerals (Quartz, Plagioclase, Microcline, Olivine, Augite, Hornblende, Muscovite, Biotite, Garnet, Calcite, orthoclase).

**[No. of Hours: 07 ]**

### **Crystallography**

**Unit 1** Crystal form, face, edge, solid angle; Interfacial angle and their measurements; Crystallographic axes and angles. **[No. of Hours: 07 ]**

**Unit 2** Crystal parameters, Weiss and Miller system of notations. **[No. of Hours: 08 ]**

**Unit 3** Symmetry elements and description of normal class of Isometric, Tetragonal, Hexagonal, Trigonal, Orthorhombic, Monoclinic and Triclinic systems. **[No. of Hours: 08]**

**Unit 4** Twinning: Laws and Types. **[No. of Hours: 07 ]**

#### **Text Books:**

**TB1:** Dana, E.S. and Ford, W.E., 2002. A textbook of Mineralogy (Reprints).

**TB2** Berry, L.G., Mason, B. and Dietrich, R.V., 1982. Mineralogy. CBS Publ.

**TB3** Nesse, D.W., 1986. Optical Mineralogy. McGraw Hill.

#### **Reference Books:**

**RB1** Read, H.H., 1968. Rutley's Element of Mineralogy (Rev. Ed.). Thomas Murby and Co.

**RB2** Berry and Mason, 1961. Mineralogy. W.H. Freeman & Co.

**RB3** Kerr, B.F., 1995. Optical Mineralogy 5th Ed. McGraw Hill, New York.

#### **Course outcomes (COs):**

**Upon successful completion of the course a student will be able to**

CO1	Learn and Gain Knowledge to the different properties of minerals, silicate structure, Polarizing microscope, Optical properties of mineral, Interfacial angle, Crystallographic axes, Miller system of notations, description of normal classes, and twinning.
CO2	To Understand the mode of occurrences and uses of different mineral groups, silicate structures, optical properties of common minerals, description of normal classes of common crystal.
CO3	Differentiate different crystal systems on the basis of symmetry and other properties, laws of twinning.

CO4	Measure interfacial angle by using contact goniometer, give different notations in crystal.
CO5	Distinguish different minerals on the bases of physical properties, optical properties, crystal system on the bases of symmetry.
CO6	Write the concept of Polarizing microscope.

### CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	2	2	2	2	3	1	3	2	2	1	2	1	2	2
CO2	1	2	2	2	2	2	3	1	3	2	2	2	1	1	2	2
CO3	2	2	2	2	2	2	1	1	3	2	3	3	2	2	2	2
CO4	1	1	1	2	2	1	3	1	3	2	2	1	1	1	1	1
CO5	2	1	2	2	1	2	3	1	3	2	3	3	2	2	1	2
CO6	2	3	2	3	2	2	3	3	3	1	2	3	3	2	2	1

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

### Programme Name: B.Sc. Geology

<b>Course code</b>	: BGLL201			
<b>Course Name</b>	: Lab Course based on BGLC201			
<b>Semester /Year</b>	: II			
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

L - Lecture T – Tutorial P – Practical C – Credit

### Course Objectives: The objectives of this course are

1. To understand the common rock-forming minerals in hand specimens.
2. To understand the optical properties of minerals.

### Course Contents

#### • 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.

#### • Crystallography:

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

#### • Geological Field Training:

Students will be required to carry out 01 days field work in a suitable geological area to study the elementary aspects of field geology and submit a report there on.

### Text Books:

**TB1: Rabindra Nath Hota, Practical Approach to Crystallography and Mineralogy, cbs**

publishers and distributors pvt ltd; 2nd edition (30July 2017).

**Reference Books:**

**RB1:** **C.D. Gribble**, Rutley's Elements of Mineralogy, 27e [Print Replica] Kindle Edition; cbs publishers and distributors pvt ltd; Twenty Seven Edition (1 December 2005)

**Course outcomes (COs):**

**Upon successful completion of the course a student will be able to**

<b>CO1</b>	Identify common rock-forming minerals in hand specimens.
<b>CO2</b>	Understand common rock-forming minerals in thin section.
<b>CO3</b>	Determination of system and class of crystals on the basis of symmetry elements.
<b>CO4</b>	Analyze the hand specimen and rock slide.
<b>CO5</b>	Compare the hand specimen of minerals on the bases of Physical properties of minerals
<b>CO6</b>	Write the notations in crystal system.

**CO-PO-PSO Mapping**

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	2	2	2	1	1	3	2	3	3	2	2	2	2
CO2	2	2	2	2	2	2	1	1	3	2	3	3	2	2	2	2
CO3	1	1	2	2	2	1	1	1	3	2	3	3	2	1	1	2
CO4	1	1	1	2	2	1	3	1	3	2	2	1	1	1	1	1
CO5	2	1	2	2	1	2	3	1	3	2	3	3	2	2	1	2
CO6	2	3	2	3	2	2	3	3	3	1	2	3	3	2	2	<b>1</b>

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

**Programme Name: B.Sc. Geology**

<b>Course code</b>	<b>: BGLC301</b>			
<b>Course Name</b>	<b>: Petrology</b>			
<b>Semester /Year</b>	<b>: III</b>			
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

L - Lecture T – Tutorial P – Practical C – Credit

**Course Objectives: The objectives of this course are**

1. To understanding the textures, structures, classification of Igneous Rock.
2. To understanding the textures, structures, classification of Sedimentary Rock.
3. To understanding the textures, structures, classification of Metamorphic Rock.

## Course Contents

### **Igneous Petrology**

**Unit 1** Introduction to petrology, Magma: definition, composition and constitution, types and origin; Forms of igneous rocks. **[No. of Hours: 07]**

**Unit 2** Differentiation and Assimilation; Crystallization of uni-component and bi-component (mix-crystals); Bowen's reaction principle. **[No. of Hours: 08]**

**Unit 3** Mineralogical and chemical classification of igneous rocks, textures and structure of igneous rocks. **[No. of Hours: 07]**

**Unit 4** Detailed petrographic description of Granite, Granodiorite, Basalt, Rhyolite, Syenite, Phonolite, Diorite, Gabbro and their volcanic equivalent. **[No. of Hours: 08]**

### **Sedimentary Petrology & Metamorphic Petrology**

**Unit 5** Processes of formation of sedimentary rocks; Classification, textures and structures of sedimentary rocks; sedimentary facies. **[No. of Hours: 08]**

**Unit 6** Petrographic details of important siliciclastic and carbonate rocks such as - conglomerate, breccia, sandstone, greywacke, shale, limestone. **[No. of Hours: 07]**

**Unit 7** Process and products of metamorphism; Type of metamorphism. Factors, zones and grade of metamorphism; Textures and structures of metamorphic rocks. **[No. of Hours: 08]**

**Unit 8** : Petrographic details of some important metamorphic rocks such as - slate, phyllite, schist, gneiss, quartzite, marble, amphibolite, granulite. **[No. of Hours: 07]**

#### **Text Books:**

**TB1:** Turner, F.J. & Verhoogen, J., 1960, Igneous & Metamorphic petrology. McGrawHill Co.

**TB2 :** Prasad, C., 1980. A text book of sedimentology

**TB3 :** Mason, R., 1978. Petrology of Metamorphic Rocks. CBS Publ.

#### **Reference Books:**

**RB1:** Pettijohn, F.J., 1975. Sedimentary rocks, Harper & Bros. 3rd Ed.

**RB2:** Sengupta, S., 1997. Introduction to sedimentology. Oxford-IBH.

**RB3:** Moorhouse, WW., 1969. The study of rocks in thin sections. Harper and sons.

**Course outcomes (COs):**

**Upon successful completion of the course a student will be able to**

<b>CO1</b>	Learn and Gain Knowledge of characterize, identify and name different types of rocks in the field and in hand-specimens, and rock-thin sections, and finally they will propose the rock-forming processes.
<b>CO2</b>	Understand the formation , , texture, structure of Igneous rock, Sedimentary rock and Metamorphic rock.
<b>CO3</b>	Explain the use of Petrography of Igneous , Sedimentary and Metamorphic rock.
<b>CO4</b>	Classify the Igneous rock, Sedimentary rock and Metamorphic rock, Crystallization of uni-component and bi-component (mix-crystals); Bowen's reaction principle
<b>CO5</b>	Distinguish between different type of rocks.
<b>CO6</b>	Write the process of metamorphism, agents of metamorphism, petrography of metamorphic rock.

**CO-PO-PSO Mapping**

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	2	2	2	1	1	3	2	2	1	1	2	2	1
CO2	1	2	2	2	2	2	1	1	3	2	2	2	1	1	2	2
CO3	1	1	1	2	2	1	1	1	3	2	2	1	1	1	1	1
CO4	2	2	2	2	1	2	1	1	3	2	3	2	2	2	2	2
CO5	2	1	2	2	1	2	3	1	3	2	3	3	2	2	1	2
CO6	2	3	2	3	2	2	3	3	3	1	2	3	3	2	2	<b>1</b>

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

**Programme Name: B.Sc. Geology**

<b>Course code</b>	<b>: BGLL301</b>			
<b>Course Name</b>	<b>: Lab Course based on BGLC301</b>			
<b>Semester /Year</b>	<b>: III</b>			
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

L - Lecture T – Tutorial P – Practical C – Credit

**Course Contents**

**[No. of Hours: 60]**

**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.

**Text Books:**

**TB1: Rabindra Nath Hota,** Practical Approach to Petrology 2nd Edition, Kindle Edition, cbs publishers and distributors pvt ltd; 2nd edition (11 August 2020).

**Course outcomes (COs):**

**Upon successful completion of the course a student will be able to**

CO1	Describe microscopic properties of igneous, sedimentary and metamorphic rocks.
CO2	Compare different type of rocks in hand specimen and thin section.
CO3	Prepare the slides of different types of rocks.
CO4	Distinguish the rock in microscopic and macroscopic level.
CO5	Analyze the thin section of Igneous, Sedimentary rock and Metamorphic Rock.
CO6	Write the Physical properties of rocks in handspecimen.

**CO-PO-PSO Mapping**

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	2	2	2	1	1	3	2	2	1	1	2	2	1
CO2	3	2	2	2	2	2	1	1	3	3	3	3	2	3	2	2
CO3	2	2	2	2	2	2	1	1	3	2	3	3	2	2	2	2
CO4	2	2	2	2	1	2	1	1	3	2	3	2	2	2	2	2
CO5	2	1	2	2	1	2	3	1	3	2	3	3	2	2	1	2
CO6	2	2	2	2	2	2	1	1	3	2	3	3	2	2	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

**Programme Name: B.SC. Geology**

<b>Course code</b>	<b>: BGLC401</b>			
<b>Course Name</b>	<b>: Stratigraphy Principles and Indian Stratigraphy</b>			
<b>Semester /Year</b>	<b>: IV</b>			
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

L - Lecture T – Tutorial P – Practical C – Credit

### **Course Objectives: The objectives of this course are**

1. This course aims at providing a basic understanding of the various stratigraphic units
2. To understand the concept of Geological Time Scale and Facies concept
3. It aims to provide understanding of the Precambrian geology, stratigraphy, fossil content and the economic resources of the lithounits from the Peninsular India.

### **Course Contents**

### **Stratigraphy Principles and Indian Stratigraphy**

**Unit 1** Definition, types of stratigraphy , Principles of Stratigraphy, Fundamentals of litho-, bio- and chrono-stratigraphy. **[No. of Hours: 07]**

**Unit 2** Geological time scale; Stratigraphic classificaton; rock units, time units and time-rock units; Physiographic division of India. **[No. of Hours: 08]**

**Unit 3** Facies concept in stratigraphy, Walther's Law of facies succession, Introduction to concepts of dynamic stratigraphy (chemostratigraphy, seismic stratigraphy, sequence stratigraphy, magnetostratigraphy). **[No. of Hours: 09]**

**Unit 4** Introduction to Proterozoic sedimentary basins of India. Geology of Vindhyan and Cudappah basins. **[No. of Hours: 08]**

**Unit 5** Paleozoic stratigraphy of India:Palaeozoic Succession of Kashmir and its correlatives from Spiti and Zaskar Stratigraphy. Geology and hydrocarbon potential of Gondwana basins. **[No. of Hours: 10]**

**Unit 6** Mesozoic stratigraphy of India:Triassic successions of Spiti; Jurassic of Kutch; Cretaceous succession of Cauvery Basin. **[No. of Hours: 08]**

**Unit 7** : Cenozoic stratigraphy of India: Kutch basin; Siwalik succession; Assam basins; Stratigraphy and structure of Krishna-Godavari basin, Cauvery basin, Bombay offshore basin. **[No. of Hours: 10]**

### **Text Books:**

**TB1: Wadia, D.,1973.**Geology of India.McGraw Hill Book co.

**TB: Krishnan, M.S.,1982.**Geology of India and Burma,6th Edition.CBS Publ.

**TB3: RavindraKumar,1985.** Fundamentals of Historical Geology & Stratigraphy of India.



Wiley Eastern.

**Reference Books:**

**RB1 : Principle of Stratigraphy:** Dunbar and Roggers, (1964), John Wiley and co, New York

**RB2: An Introduction in Stratigraphy :** An Introduction in Stratigraphy

**RB3: Stratigraphic Principles and Practices:** Weller, J.M, (1962), Harper & Bros, New York.

**Course outcomes (COs):**

**Upon successful completion of the course a student will be able to**

CO1	Learn and Gain Knowledge of fundamentals of stratigraphic principles and various methods of stratigraphic analysis will be provided.
CO2	To understand the concept of Geological Time Scale and Facies concept,
CO3	Explain about the various age group rocks occurring in India and the boundaries separating them, Geological Time events of The Paleozoic, Gondwana, Triassic, Jurassic and Cretaceous and the Tertiary Group
CO4	The stratigraphic classification from craton, mobile belt, Proterozoic to Phanerozoic succession from India is the goal of this course.
CO5	Compare the stratigraphy succession on the bases of fossils.
CO6	Write the detailed significance of the Siwalik, Pleistocene, Holocene, Himalayas, and Eocene systems.

**CO-PO-PSO Mapping**

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	1	2	2	2	1	1	3	2	3	1	1	1	2	1
CO2	1	2	2	2	2	2	1	1	3	3	2	2	1	1	2	2
CO3	2	2	2	2	1	1	1	3	2	2	1	1	2	2	2	2
CO4	1	2	2	2	1	2	1	1	3	2	3	2	2	1	2	2
CO5	2	1	2	2	1	2	3	1	3	2	3	3	2	2	1	2
CO6	1	2	2	2	1	2	1	1	3	2	3	2	2	1	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

**Programme Name: B.Sc. Geology**

<b>Course code</b>	<b>:</b>	<b>BGLL401</b>			
<b>Course Name</b>	<b>:</b>	<b>Lab Course Based on BGLC401</b>			
<b>Semester /Year</b>	<b>:</b>	<b>IV</b>			
		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

L - Lecture T – Tutorial P – Practical C – Credit

**Course Objectives: The objectives of this course are**

1. Be able to locate the resources based on fossils.
2. To learn identify the fossils.

**Course Contents**

**[No. of Hours: 60]**

Preparation of lithostratigraphic maps of India showing distribution of important geological formations.

Assigning stratigraphy Formations based on fossils.

Study of specimens representing rock formations of Dehradun.

**Text Books:**

**TB1:** Rajeeva Guhey (1 January 2017), Geology: Principles and Practical Manua; New India Publishing Agency .

**Reference Books:**

**RB1:** Ramakrishnan, M and Vaidynadhan, R., (1994), Geology of India, Geological Society of India Publication, Bangalore. Vol. I and II.

**Course outcomes (COs):**

**Upon successful completion of the course a student will be able to**

CO1	Describe the stratigraphy sequences of various foration.
CO2	Identify hand specimens representing rock Formations of Dehradun..
CO3	Solve problems in stratigraphic correlation.
CO4	Explain the lithostratigraphic maps of India showing geological formation.
CO5	Discriminate stratigraphy Formations based on fossils
CO6	Write the various stratigraphic horizons in outline map of India

**CO-PO-PSO Mapping**

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	2	2	2	2	1	1	3	2	3	3	2	2	3	2
CO2	3	2	2	2	2	2	1	1	3	3	2	3	2	3	2	2
CO3	3	2	2	2	2	2	1	1	3	3	2	3	2	3	2	2
CO4	2	2	2	2	2	2	1	1	3	2	2	3	2	2	2	2
CO5	2	2	2	2	2	2	1	1	3	2	2	3	2	2	2	2
CO6	1	2	2	2	1	2	1	1	3	2	3	2	2	1	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

### Programme Name: B.Sc. Geology

<b>Course code</b> :	<b>BGLD501</b>				
<b>Course Name</b> :	<b>Palaeontology</b>				
<b>Semester /Year</b> :	<b>V</b>				
		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

L - Lecture T – Tutorial P – Practical C – Credit

#### **Course Objectives: The objectives of this course are**

1. To learn about the remains of plants and animals which have been preserved in the earth's crust by natural processes. With these objectives in mind it becomes pertinent to understand the basic concepts of Paleontology
2. . It would add to their knowledge regarding the basic concept of paleontology using mode and methods of fossil preservation and species identification
3. To learn about the vertebrate paleontology and Paleobotany.

#### **Course Contents**

**Unit 1** Paleontology, definition, subdivisions and scope , Fossils: definition, characters, mode of preservation, condition of fossilization and significance of fossils, Trace fossils and Ichno-fossils and Index Fossils. **[No. of Hours: 12]**

**Unit 2** Elementary ideas about origin of life and adaptation to various environments. Systematic classification of organisms. **[No. of Hours: 08]**

**Unit 3** Invertebrate Paleontology- Morphology, classification, evolutionary trends, and geological distribution of Brachiopods, Lamellibranches, Gastropods , Cephalopods, and Trilobites. **[No. of Hours: 12]**

**Unit 4** Vertebrate Paleontology: Introduction of Siwalik vertebrate fauna, evolutionary history of Equidae, Proboscidea and Hominidae. **[No. of Hours: 11]**

**Unit 5** : Introduction to Paleobotany; fossil record of plants through time; Gondwana Flora. **[No. of Hours: 09]**

**Unit 6** Principles of Sequences Stratigraphy , Micropaleontology and its uses.

**[No. of Hours: 08]**

**Text Books:**

**TB1:** Raup, D. M., Stanley, S. M., Freeman, W. H. (1971). Principles of Paleontology.

**TB2** Clarkson, E. N. K. (2012). Invertebrate paleontology and evolution 4th Edition by Blackwell Publishing

**TB3** Moore, R.C. Lalliker, C.G. and Fischer, A.G. (1952). Text book of Invertebrate Palaeontology.

**Reference Books:**

**RB1 :** Benton, M. (2009). Vertebrate paleontology. John Wiley & Sons.

**RB2 :**Schrock, Twenhofel and Williams (1953). Principles of Invertebrate Palaeontology. CBS,

**RB3 :**Shukla, A. C. and Misra, S. P. (1975). Essentials of paleobotany. Vikas Publisher.

**Course outcomes (COs):**

**Upon successful completion of the course a student will be able to**

<b>CO1</b>	Learn and gain Knowledge of fossils, conditions and modes for fossilization, Invertebrate, vertebrate Paleontology, paleobotany and Micropaleontology
<b>CO2</b>	To understand the morphology of the hard parts of different phylum's and geological time range.
<b>CO3</b>	Explain the origin and evolution of life through geological time and the major evolutionary breakthroughs, and to correlate the evolutionary history with other synchronous geological events.
<b>CO4</b>	Distinguish between vertebrate Paleontology ,Invertebrate Paleontology.
<b>CO5</b>	Distinguish between the upper Gondwana and Lower Gondwana.
<b>CO6</b>	Write the collection techniques of fossils.

**CO-PO-PSO Mapping**

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	2	2	1	1	1	3	2	2	1	1	2	2	1
CO2	1	2	1	2	2	1	1	1	3	2	1	2	1	1	2	1
CO3	1	2	1	2	2	1	1	1	3	2	1	1	1	1	2	1
CO4	2	2	1	2	2	1	1	1	3	2	2	2	1	2	2	1
CO5	2	2	1	2	2	1	1	1	3	2	2	2	1	2	2	1
CO6	2	2	1	2	2	1	1	1	3	2	2	2	1	2	2	1

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

## Programme Name: B.SC. Geology

<b>Course code</b>	:	BGLL501				
<b>Course Name</b>	:	Lab Course based on BGLD501				
<b>Semester /Year</b>	:	V				
			<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
			<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

L - Lecture T – Tutorial P – Practical C – Credit

### Course Objectives: The objectives of this course are

1. To learn about the Important invertebrate groups (Bivalvia, Gastropoda, Brachiopoda) and their biostratigraphic significance.
2. Be able to get application of fossils in Stratigraphy.

### Course Contents

[No. of Hours: 60]

Morphological characters, systematic position and age of fossil genera pertaining to brachiopods, pelecypods, cephalopods, and trilobite .

Study of plants fossils.

### Course outcomes (COs):

**Upon successful completion of the course a student will be able to**

<b>CO1</b>	Gain Knowledge regarding the identification of fossils.
<b>CO2</b>	To identify fossils/casts/shells w.r.t their morphology and geological age.
<b>CO3</b>	To collect the rock sample from the field
<b>CO4</b>	Correlate the formation of rock on the basis of fossils.
<b>CO5</b>	Compare the rock succession on the basis of fossils.
<b>CO6</b>	To identify the Plant fossils and write its uses

### CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	2	2	2	2	1	1	3	2	3	3	2	2	3	2
CO2	2	2	2	2	2	2	1	1	3	3	3	3	2	2	2	2
CO3	1	2	1	2	2	1	1	1	3	2	1	1	1	1	2	1
CO4	2	2	1	2	2	1	1	1	3	2	2	2	1	2	2	1
CO5	2	2	2	2	2	2	1	1	3	3	3	3	2	2	2	2
CO6	2	2	2	2	2	2	1	1	3	3	3	3	2	2	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

## Programme Name: B.Sc. Geology

Course code	: BGLD502				
Course Name	: Element of Geochemistry				
Semester /Year	: V				
		L	T	P	C
		4	0	0	4

L - Lecture T – Tutorial P – Practical C – Credit

### Course Objectives: The objectives of this course are

- 1.To learn about the basic concept of Geochemistry.
- 2.To Understand the Geochemistry of Solid Earth.

### Course Contents

**Unit 1** Introduction to properties of elements: The periodic table, Chemical bonding, states of matter and atomic environment of elements ,Geochemical classification of elements

[No. of Hours: 10 ]

**Unit 2** Layered structure of Earth and geochemistry ,Composition of different Earth reservoirs and the nuclides and radioactivity , Conservation of mass, isotopic and elemental fractionation Concept of radiogenic isotopes in geochronology and isotopic tracers.

[No. of Hours: 10 ]

**Unit 3** Element transport , Advection and diffusion , Chromatography , Aqueous geochemistry- basic concepts and speciation in solutions, Eh, pH relations , Elements of marine chemistry Mineral reactions- diagenesis and hydrothermal reactions

[No. of Hours:10 ]

**Unit 4** Geochemistry of solid Earth ,The solid Earth – geochemical variability of magma and its products

[No. of Hours: 10 ]

**Unit 5** The Earth in the solar system, the formation of solar system , Composition of the bulk silicate Earth, Meteorites

[No. of Hours: 10 ]

**Unit 6** Geochemical behavior of selected elements like Si, Al, K, Na....[No. of Hours: 10 ]

### Text Books:

**TB1:** Mason, B. (1986) Principles of Geochemistry. 3rd Edition, Wiley New York.

**TB2:** Walther, J. V. (2009). Essentials of geochemistry. Jones & Bartlett Publishers.

### Reference Books:

**RB1:** Albarède, F. (2003). Geochemistry: an introduction. Cambridge University Press.

**RB2:** Faure, Gunter and Teresa M. Mensing (2004). Isotopes: Principles and Applications, Wiley India Pvt. Ltd

**Course outcomes (COs):****Upon successful completion of the course a student will be able to**

<b>CO1</b>	Learn and Gain Knowledge of the basic concept of the Geochemistry, Structure of earth ,geochemistry of earth, solar system, geochemical behaviour of different elements, Chromatography, Eh, pH relations
<b>CO2</b>	Discuss the geochemical classification of elements, Major, minor and trace and elements
<b>CO3</b>	Explain element partitioning in minerals and rocks.
<b>CO4</b>	Idea about Geochemical classification of elements.
<b>CO5</b>	Distinguish between the different Layer of Earth.
<b>CO6</b>	Write the chemical composition characteristics of the Earth,

**CO-PO-PSO Mapping**

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	1	2	2	2	1	1	3	2	2	2	1	1	2	1
CO2	1	2	2	2	2	2	1	1	3	2	2	2	1	1	2	2
CO3	1	2	2	2	2	2	1	1	3	2	2	2	1	1	2	2
CO4	2	2	2	2	1	2	1	1	3	2	3	2	1	2	2	2
CO5	2	2	2	2	1	2	1	1	3	2	3	2	1	2	2	2
CO6	2	2	2	2	1	2	1	1	3	2	3	2	1	2	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

**Programme Name: B.Sc. Geology**

<b>Course code</b>	<b>BGLL502</b>			
<b>Course Name</b>	<b>: Lab Course based on BGLD502</b>			
<b>Semester /Year</b>	<b>: V</b>			
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

L - Lecture T – Tutorial P – Practical C – Credit

**Course Objectives :The objectives of this course are**

Students Gain Practical Knowledge of Chromatography and PH meter.

**Course Contents****[No. of Hours: 60]**

1. Paper Chromatographic separation of Fe<sup>3+</sup>, Al<sup>3+</sup> and Cr<sup>3+</sup>
2. Determination of PH of soil samples.

3. Determination of dissolve Oxygen in water.
4. Determination of chemical oxygen demand (COD)
5. Determination of biological oxygen demand.
6. Determination alkalinity of water samples by using double titration methods.

**Text Books:**

**TB1** : Svehla, G. Vogels qualitative inorganic analysis, Pearson Education ,2012

**TB2** : Mendham, J. Vogels quantitative chemical analysis, Pearson Education, 2009

**Course outcomes (COs):**

**Upon successful completion of the course a student will be able to**

<b>CO1</b>	Gain Practical Knowledge of Chromatographic Separation.
<b>CO2</b>	Understand the Practical Concept of PH, dissolve Oxygen in water, chemical oxygen demand.
<b>CO3</b>	Determine the PH of soil samples
<b>CO4</b>	Analyzing the techniques used in geochemical analysis
<b>CO5</b>	Evaluate the result of dissolve Oxygen in water.
<b>CO6</b>	Explain the methodology used in double titration methods.

**CO-PO-PSO Mapping**

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	2	2	2	2	1	1	3	2	3	3	1	2	3	2
CO2	1	2	2	2	2	2	1	1	3	2	2	2	1	1	2	2
CO3	1	2	2	2	2	2	1	1	3	2	2	2	1	1	2	2
CO4	2	2	2	2	1	2	1	1	3	2	3	2	1	2	2	2
CO5	1	2	2	2	2	2	1	1	3	2	2	2	1	1	2	2
CO6	1	2	2	2	2	2	1	1	3	2	2	2	1	1	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated



## Programme Name: B.Sc. Geology

<b>Course code</b>	<b>: BGLD601</b>			
<b>Course Name</b>	<b>: Economic Geology and Hydrology</b>			
<b>Semester /Year</b>	<b>: VI</b>			
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

L - Lecture T – Tutorial P – Practical C – Credit

### **Course Objectives: The objectives of this course are**

1. The student is introduced to the basic principles of Economic geology and hydrology.
2. To teach the students about valuable economic ore , metallic and non-metallic minerals, process of formation of ore deposits, hydrological cycle
3. To learn about the hydrological cycle, origin of ground water and groundwater exploration methods.

### **Course Contents**

#### **Economic Geology**

**Unit 1** 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.

**[No. of Hours: 07]**

**Unit 2** Processes of formation of ore deposits; Magmatic, Mechanical and residual concentration, contact metasomatic, hydrothermal, sedimentation, oxidation, supergene enrichment.

**[No. of Hours: 08]**

**Unit 3** Study of important metallic (Cu, Pb, Zn, Mn, Fe, Au, Al) and non-metallic(industrial) minerals (gypsum, magnesite, mica), mineral resources of Uttarakhand.

**[No. of Hours: 08]**

**Unit 4** Distribution of coal and petroleum in India, gas hydrate, coal bed methane.

**[No. of Hours: 07 ]**

#### **Hydrology**

**Unit 1** Definition of hydrogeology, Hydrological cycle; Water bearing properties of rocks.

**[No. of Hours: 07]**

**Unit 2** Hydrological parameters - Precipitation, evaporation, transpiration and infiltration. .

[No. of Hours: 07]

**Unit 3** Origin of groundwater; Vertical distribution of ground water; Types of aquifers. .

[No. of Hours: 08]

**Unit 4** Surface and subsurface geophysical and geological methods of ground water exploration; Ground water resources of Uttarakhand. .

[No. of Hours: 08]

**Text Books:**

**TB1: Brown, C. and Dey,A.K.**1955. Indian Mineral Wealth. Oxford Univ.

**TB2: Todd.D.K,** ground water hydrology, wiley pub.

**TB3 :Umeshwar Prasad,** 2003. Economic Geology.CBS Publishers and distributors.

**Reference Books:**

**RB1: Karanth,K. R.,** 1989. Hydrogeology. Tata Mc GrawHill Publ.

**RB2: Krishnaswamy, S.,** 1979.India's Minerals Resources. Oxford and IBH Publ.

**RB3: Sharma, N.L. and Ram, K.V.S.,** 1972. Introduction to India's Economic Minerals, Dhanbad.

**Course outcomes (COs):**

**Upon successful completion of the course a student will be able to**

<b>CO1</b>	Learn and Gain knowledge of basic principles of economic geology, Processes of formation of ore deposits, metallic minerals, coal ,petroleum, Hydrological cycle, hydrological parameters, origin of earth, geophysical and geological methods of groundwater.
<b>CO2</b>	Understand the economic value of the ores, Hydrological cycle, origin of groundwater.
<b>CO3</b>	Explain the formation of ore deposits and coal and petroleum in India.
<b>CO4</b>	Analyze Groundwater Quality with different methods.
<b>CO5</b>	Distinguish between various ore deposits of India and Aquifers.
<b>CO6</b>	To explore groundwater regime through various geophysical methods

## CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	1	2	2	2	1	1	3	2	1	1	2	1	2	1
CO2	1	2	2	2	2	2	1	1	3	2	2	2	1	1	2	2
CO3	1	2	1	2	2	1	1	1	3	2	2	1	1	1	2	1
CO4	1	2	1	2	1	1	1	1	3	2	1	2	1	1	2	1
CO5	1	2	2	2	2	2	1	1	3	2	2	2	1	1	2	2
CO6	1	2	1	2	1	1	1	1	3	2	1	2	1	1	2	1

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

## Programme Name: B.Sc. Geology

<b>Course code</b>	<b>BGLL601</b>			
<b>Course Name</b>	<b>: Lab Course based on BGLD601</b>			
<b>Semester /Year</b>	<b>: VI</b>			
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

L - Lecture T – Tutorial P – Practical C – Credit

### Course Objectives :The objectives of this course are

- 1.To analyse the Ore samples.
- 2.To learn about the preparation of Ore map.
3. To solve the numerical problem based on hydrology.

### Course Contents

[No. of Hours: 60]

**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 hydrogeological models, Estimation of porosity and permeability from the given data; Preparation and interpretation of water table maps.

### Text Books:

**TB1 Todd.D.K,** ground water hydrology, wiley pub.

### Course outcomes (COs):

**Upon successful completion of the course a student will be able to**

<b>CO1</b>	Gain Knowledge samples of ore deposits.
<b>CO2</b>	Understand Understand the distribution of minerals in India.
<b>CO3</b>	Prepare of maps showing distribution of important metallic and non-metallic deposits and important coal and oil fields of India.
<b>CO4</b>	Analyze the samples of economic minerals.
<b>CO5</b>	Compare the different ore minerals.
<b>CO6</b>	Solve the problems based on porosity, permeability, specific yield, retention, aquifer..

### CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	3	1	2	2	2	1	1	3	2	3	3	2	1	3	1
CO2	3	2	2	2	2	1	1	1	3	3	3	3	2	3	2	2
CO3	2	2	2	2	2	1	1	1	3	2	3	3	2	2	2	2
CO4	1	2	1	2	1	1	1	1	3	2	1	2	1	1	2	1
CO5	2	2	2	2	2	1	1	1	3	2	3	3	2	2	2	2
CO6	2	2	2	2	2	1	1	1	3	2	3	3	2	2	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

### Programme Name: B.SC. Geology

<b>Course code</b>	: BGLD602			
<b>Course Name</b>	: Engineering and Disaster Management			
<b>Semester /Year</b>	: VI			
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

L - Lecture T – Tutorial P – Practical C – Credit

### Course Objectives: The objectives of this course are

1. To learn about the basic principles of Engineering geology and disaster.
2. To understand the site selection of Dams , Tunnels and bridge:
3. To learn about the process and prevention measures of disaster concept.

## **Course Contents**

**Unit 1** Engineering properties of rocks and Soils. **[No. of Hours:07 ]**

**Unit 2 Dam**, Types and their geological and environmental considerations; Geological problem of reservoirs. **[No. of Hours:08 ]**

**Unit 3** Tunnel definition, terminology, types, geological investigation and tunnel problems. **[No. of Hours: 08]**

**Unit 4 :** Bridges: Definition, Terminology, geological investigation and stability of bridge. **[No. of Hours: 07]**

**Unit 5:** Understanding disaster Concept and definitions of different terms of disaster, classification of disasters- natural, manmade; difference between disaster and hazard-atmospheric and geo- hazards, Disaster risk, Vulnerability. **[No. of Hours: 07]**

**Unit6:** Volcanoes: type of volcanoes – causes of volcanoes – products of volcanoes. Destruction due to volcanic eruptions. Major volcanic eruptions in India. **[No. of Hours: 08]**

**Unit 7:** Landslides: definition – terminology – classification. Causes of landslides: slope changes – tectonic activity – rock structures – role of water in landslides – effects of Human activity. Destruction due to landslides – precautionary measures.

**[No. of Hours: 08]**

**Unit 8 :** Tsunamis: definition – causes of tsunami: submarine earthquakes and tsunamis – Impact of tsunamis ,Major Tsunamis. **[No. of Hours: 07 ]**

### **Text Books:**

**TB1 Krynine D.P. and Judd W.R.,1957.**Principles of Engineering Geology & Geotechnics. McGraw-Hill Book.

**TB2 Radhakrishnan,V. (1996).** General Geology, V.V.P. Publishers,Tuticorin.

**TB3 Kesavulu, N.C., 2009.** A text book of engineering geology. Macmillan P publishing India Ltd.

### **Reference Books:**

**RB1 :. Mahapatra,G.P. (1994).** Physical Geology,CBS Publishers,New Delhi.

**RB2: Crozier. M.J.,1989.**Landslides: causes, consequences and environment.AcademicPress.

### Course outcomes (COs):

Upon successful completion of the course a student will be able to

<b>CO1</b>	Gain Knowledge of the basic principles of Engineering geology and disaster.
<b>CO2</b>	Understand Engineering properties of rocks, selection of Dam , tunnel and bridge.
<b>CO3</b>	Explain the concept of Earthquake, Volcanoes, landslide.
<b>CO4</b>	Analyze influence of geological conditions on various engineering structures
<b>CO5</b>	Awareness of natural disasters for future safety measures and preparedness
<b>CO6</b>	Solve the problems based on dam and tunnel.

### CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	2	2	2	1	1	3	2	2	1	1	2	1	2	2
CO2	2	2	2	2	2	2	1	2	3	2	3	2	1	2	2	2
CO3	2	2	2	2	3	2	1	2	3	2	2	2	1	2	2	2
CO4	2	2	2	2	2	2	1	2	3	2	2	2	1	2	2	2
CO5	2	2	2	2	2	1	1	1	3	2	3	3	2	2	2	2
CO6	2	2	2	2	2	2	1	2	3	2	2	2	1	2	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

### Programme Name: B.Sc. Geology

<b>Course code</b>	<b>: BGLL602</b>			
<b>Course Name</b>	<b>: Lab Course based on BGLD602</b>			
<b>Semester /Year</b>	<b>: VI</b>			
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

L - Lecture T – Tutorial P – Practical C – Credit

### Course Objectives: The objectives of this course are

- 1.To learn about the preparation of geological map.
- 2.To learn about the identification of rocks on the bases o Engineering Properties of rocks.

3. To learn grain size analysis.

### Course Contents

[No. of Hours: 60]

Preparation of engineering geological maps;

Engineering properties and identification of building stones.

Identification of various models of landslide, tunnel and dam.

Grain size analysis of soil and sediments.

**One day visit any dam site of Uttarakhand.**

### Text Book

**TB1** Dr. Harish Kapasya, Publisher: Himanshu Publications.

### Course outcomes (COs):

**Upon successful completion of the course a student will be able to**

<b>CO1</b>	Gain Knowledge Preparation of engineering geological maps
<b>CO2</b>	Explain the model of tunnel.
<b>CO3</b>	Explain the the model of dam.
<b>CO4</b>	Analyze the grain size of soil and sediments.
<b>CO5</b>	Distinguish between different rocks on the basis of Engineering properties.
<b>CO6</b>	Solve the problem based on landslide.

### CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	2	2	2	1	1	3	2	3	3	2	2	2	2
CO2	2	2	2	2	2	2	1	1	3	3	3	3	2	2	2	2
CO3	2	2	2	2	2	2	1	1	3	2	3	3	2	2	2	2
CO4	2	2	2	2	2	2	1	2	3	2	2	2	1	2	2	2
CO5	2	2	2	2	2	2	1	1	3	2	3	3	2	2	2	2
CO6	2	2	2	2	2	2	1	1	3	2	3	3	2	2	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

## SKILL ENHANCEMENT COURSE

### Programme Name: B.Sc. Geology

<b>Course code</b>	<b>: BGLS302</b>				
<b>Course Name</b>	<b>: Geomorphology and Geotectonic</b>				
<b>Semester /Year</b>	<b>: III</b>				
		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

L - Lecture T – Tutorial P – Practical C – Credit

#### **Course Objectives: The objectives of this course are**

1. To learn about the basic principles of geomorphology.
2. To understand the Earth dynamic system.
3. To learn about the tectonics .

#### **Course Contents**

**Unit 1** Basic principles of Geomorphology, geomorphological cycles, weathering and erosion; Geomorphic mapping- tools and techniques. **[No. of Hours: 15]**

**Unit 2** Epigene/exogenic processes: degradation and aggradation. Diastrophism and volcanism, Geological work of wind, glacier, river, underground water and ocean.

**[No. of Hours: 15]**

**Unit 3** Earth as a dynamic system. Elementary idea of continental drift, sea- floor spreading and mid-oceanic ridges. Paleo magnetism and its application, isostasy.

**[No. of Hours: 15]**

**Unit 4 Plate** Tectonics: the concept, plate margins, , deep sea trenches, island arcs and volcanic arcs, orogeny and rift valley.

**[No. of Hours: 15]**

#### **Text Books:**

**TB1:** Allen, P., 1997. Earth Surface Processes. Blackwell

**TB2:** Bloom, A.L., 1998. Geomorphology: A Systematic Analysis of Late Cenozoic Landforms (3rd Edition).

**TB3:** Moores, E and Twiss. R.J., 1995. Tectonics. Freeman.



**Reference Books:****RB1:** Patwardhan,A. M.,1999. The Dynamic Earth System. Prentice Hall.**RB2:** Valdia,K.S., 1988. Dynamic Himalaya. Universities Press, Hyderabad.**Course outcomes (COs):****Upon successful completion of the course a student will be able to**

<b>CO1</b>	Gain Knowledge of Principles of Geomorphology, natural agents of wind ,river, glacier, dynamic system of Earth, Plate tectonics.
<b>CO2</b>	Identify the landforms formed by the tectonic activities and the geological work done by a river , glacial processes and wind.
<b>CO3</b>	Apply the principles of Geomorphology in various studies.
<b>CO4</b>	Distinguish between divergent plate and convergent plate boundaries, weathering and erosion, Epigene/exogenic processes:
<b>CO5</b>	Compare the geological work done by river with that of glacier, continental drift.
<b>CO6</b>	Write the concept of plate margins, , deep sea trenches, island arcs and volcanic arcs, orogeny and rift valley, sea- floor spreading and mid-oceanic ridges, Paleo magnetism, isostasy.

**CO-PO-PSO Mapping**

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	1	2	2	2	-	1	3	2	2	1	1	1	2	1
CO2	1	2	2	2	2	2	1	3	2	2	2	1	1	2	2	2
CO3	2	2	2	2	2	2	1	1	3	2	3	3	2	2	2	2
CO4	1	1	1	2	2	1	1	3	2	2	1	1	1	1	1	2
CO5	2	2	2	2	2	2	1	1	3	2	3	3	2	2	2	2
CO6	1	1	1	2	2	1	1	3	2	2	1	1	1	1	1	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

**Programme Name: B.Sc. Geology**

<b>Course code</b>	<b>: BGLS402</b>			
<b>Course Name</b>	<b>: Micropaleontology &amp; Oceanography</b>			
<b>Semester /Year</b>	<b>: IV</b>			
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

L - Lecture T – Tutorial P – Practical C – Credit

**Course Objectives: The objectives of this course are**

- 1.To Understand the Micropaleontology and Oceanography.
- 2.To Understand the Morphology of Microfossils..
3. To understand about the ocean circulation.

**Course Contents**

**Unit 1** Definition and scope of the subject, surface and subsurface sampling methods, sample processing and techniques. slide preparation. **[No. of Hours: 15]**

**Unit 2** Morphology, geological distribution, evolution and applications of-Foraminifers, Ostracoda, Radiolaria, Diatoms and Conodonts **[No. of Hours: 15]**

**Unit 3** History and development of Oceanography. Methods of measuring properties of seawater. **[No. of Hours: 15]**

**Unit 4** Ocean circulation, surface circulation and concept of mixed layers. Thermocline and Pycnocline, concept of upwelling. El Nino and deep Ocean circulation. **[No. of Hours: 15]**

**Text Books:**

**TB1:** Saraswati P. K. and Srinivasan M. S. (2016). Micropaleontology: Principles and Applications, Springer.

**TB2:** David Tolmazin (1985). Elements of Dynamic Oceanography, Allen and Unwin

**Reference Books:**

**RB1 :** Grant Gross, M. (1977). Oceanography; A view of the Earth, Prentice Hall.

**RB2:** Pinet P. R. (1992): Oceanography: An introduction to the Planet Oceanus, West Pub, Co

**Course outcomes (COs):**

**Upon successful completion of the course a student will be able to**

CO1	Gain Knowledge to develop skills regarding modern techniques and methods employed in micropalaeontology and marine life
CO2	To understand the different Ocean drilling program
CO3	Uses of microfossils and will be able to interpret atmospheric and oceanic circulation systems so as to analyze their driving forces
CO4	Analyze the microfossils on the basis of morphology.
CO5	Evaluate a relationship between ocean chemistry and climate change
CO6	Write the concept of upwelling. El Nino and deep Ocean circulation

## CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	1	2	2	2	1	1	3	2	2	2	1	1	2	1
CO2	1	2	2	2	2	2	1	3	2	2	2	1	1	2	2	2
CO3	2	2	2	2	2	2	1	1	3	2	3	3	2	2	2	2
CO4	1	1	1	2	2	1	1	3	2	2	1	1	1	1	1	2
CO5	2	2	2	2	2	2	1	1	3	2	3	3	2	2	2	2
CO6	1	1	1	2	2	1	1	3	2	2	1	1	1	1	1	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

## Programme Name: B.SC. Geology

<b>Course code</b>	<b>: BGLS503</b>			
<b>Course Name</b>	<b>: FIELD GEOLOGY</b>			
<b>Semester /Year</b>	<b>: V</b>			
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

L - Lecture T – Tutorial P – Practical C – Credit

### Course Objectives: The objectives of this course are

1. To Provide basic knowledge of surveying techniques.
2. To upgrade and relate the theoretical knowledge of Geological aspects to field observations.
3. Learn to plan for a geology field trip.

### Course Contents

**Unit 1** Definition and scope of Field Geology – Prior planning – Basic equipment required for field work – Types of field investigations. Field work objectives and types of data collected. Introduction to topographic maps: parts, symbols, and other information. Basic concepts: relief, contours, slope, gradients, profiles and sections.

**[No. of Hours: 25]**

**Unit 2** Clinometer compass: different parts and their functions. Measuring attitude of linear structures – determination of bearings – advantages and limitations. Brunton Compass: different parts and their functions.

**[No. of Hours: 15]**

**Unit 3** Field geological report: parts and preparation. Geological and topographic map

symbols. Brief introduction of field indicators used in geological mapping: geomorphological, weathering, mineral composition and petrography. Geological materials: types of samples – mineral, ore, fossil, rock. Methods of sampling -care and packing of samples in the field. outline of preparation of thin sections of geological samples.

**[No. of Hours: 20]**

**Text Books:**

**TB1 Lahee, F** (1987). Field Geology, CBS Publishers, New Delhi.

**TB2 Gokhale, N.W.** (2001). A Guide to Field Geology. CBS Publishers, New Delhi

**Reference Books:**

**RB1 McClay, K.R.** (2003) The Mapping of Geological Structures, 2<sup>nd</sup> ed., John Wiley & Sons Ltd, New Delhi.

**RB2 Barnes, J.W.** (2004). Basic Geological Mapping. John Wiley & Sons Inc., New Delhi.

**Course outcomes (COs):**

**Upon successful completion of the course a student will be able to**

CO1	Learn and Gains knowledge into the methods of geological mapping and can gain expertise by proper practice.
CO2	Understand Rock outcrop.
CO3	Use of field note book and information on personal safety and camping.
CO4	Analyze the rock samples in field.
CO5	Measure the dip direction and dip strike from the clinometer compass.
CO6	Prepare field geological reports

**CO-PO-PSO Mapping**

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	2	2	1	1	1	3	2	2	2	1	2	2	2
CO2	2	2	2	2	2	1	1	1	3	2	2	2	1	2	2	2
CO3	2	2	2	2	2	2	1	1	3	2	3	3	2	2	2	2
CO4	1	1	1	2	2	1	1	3	2	2	1	1	1	1	1	2
CO5	2	2	2	2	2	2	1	1	3	2	3	3	2	2	2	2
CO6	1	1	1	2	2	1	1	3	2	2	1	1	1	1	1	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

**Programme Name: B.Sc. Geology**

**Course code : BGLS603**

<b>Course Name</b>	<b>: Remote Sensing and GIS</b>			
<b>Semester /Year</b>	<b>: VI</b>			
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

L - Lecture T – Tutorial P – Practical C – Credit

**Course Objectives: The objectives of this course are**

- 1.To learn remote sensing principles, purposes, advantages and limitations.
2. The basic concepts of image production, processing and interpretations are covered.
3. To learn about GIS component.

**Course Contents**

**Unit 1** Elementary idea about photo geology: electro-magnetic spectrum, types & geometry of aerial photo graphs; factors affecting aerial photography; types of camera, film and filters; factors affecting scale. **[No. of Hours: 15]**

**Unit 2** 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. **[No. of Hours: 15]**

**Unit 3** Types of Indian and Foreign Remote Sensing Satellites, Digital image processing; fundamental steps in image processing; elements of pattern recognition and image classification. **[No. of Hours: 15]**

**Unit 4** : Introduction to Geographic Information System (GIS); components of GIS; product generation in GIS; tools for map analysis; integration of GIS with remote sensing. **[No. of Hours: 15]**

**Text Books:**

**TB1:** Bhatta, B.,2008. Remote Sensing and GIS. Oxford, New Delhi.

**TB2:** Pandey, S.N.,1987.Principles and Application of Photo geology. Wiley Eastern, New Delhi.

**Reference Books:**

**RB1** : Siegal, B.S. and Gillespie,A.R.,1980. Remote Sensing in Geology .John Wiley.

**RB2:** Gupta, R.P.,1990. Remote Sensing Geology. Springer Verlag.

**Course outcomes (COs):**

**Upon successful completion of the course a student will be able to**

<b>CO1</b>	Learn and Gain Knowledge of Remote sensing and GIS.
<b>CO2</b>	To understand the interpretation of photography.
<b>CO3</b>	Use of Remote Sensing in various field.
<b>CO4</b>	Analyze various physiographical features through GIS
<b>CO5</b>	Evaluate the data with the help of satellites.
<b>CO6</b>	Write the GIS concept.

**CO-PO-PSO Mapping**

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	2	2	1	1	1	3	2	2	2	1	2	2	2
CO2	2	2	2	2	2	1	1	1	3	2	2	2	1	2	2	2
CO3	2	2	2	2	2	2	1	1	3	2	3	3	2	2	2	2
CO4	1	1	1	2	2	1	1	3	2	2	1	1	1	1	1	2
CO5	2	2	2	2	2	2	1	1	3	2	3	3	2	2	2	2
CO6	1	1	1	2	2	1	1	3	2	2	1	1	1	1	1	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated