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]

SYLLABUS FOR

First Four Years of Higher Education

PROPOSED STRUCTURE OF (NEP)

Bachelor of Science (B.Sc.)- Geology

School of Basic & Applied Sciences

OUTCOME BASED EDUCATION

PROGRAMME OUTCOMES (POs)	
The curricula of the subject of geology are designed keeping in view the following programmeoutcomes:	
PO1	Enabling the students to understand the age, composition, structure, processes, andEvolutionary history of the Earth.
PO2	Enabling the students to identify, locate, explore, judiciously exploit, and manage variousEarth resources like minerals, fossil fuel and natural gas, coal, building stones, weathered Crust and soils, underground and surface water etc.
PO3	Correlating the principles and findings of science to the scientific world and apply them in everyday life.
PO4	Enabling the students to understand and assess the potential of natural processes in causinghazards and disasters
PO5	Enabling the students to understand such geological conditions that make the terrain proneto natural and anthropogenic hazards.
PO6	Enabling the students to assess the suitability of terrain for various civil engineering constructions such as dams, reservoirs, bridges, tunnels, roads, railway lines, cable-cars,and buildings etc.
PO7	Enabling the students to formulate and execute guidelines for safe developmentalactivities in diverse geological terrains.
PO8	Ability to devise and carry out an independent field-based project, including the formulation and testing of hypotheses whilst in the process of carrying out the project.
PO9	Graduates will acquire effective communication skills
PO10	Evolving sustainable solutions for complex problems of the society in general and for public health and safety, cultural, societal and environmental anomalies.
PO11	Develop skills in gathering and interpreting the geological and geophysical data used to gain this understanding and thereby equip students with the foundations for their professional careers or additional study.

PO12	Motivating the students to take up higher studies and research to bringing out newknowledge Yet to be understood the geological aspects of the Earth.

Programme Specific Outcomes (PSOs) **UG I Year/Certificate Course in Science**	
Programme Specific Prerequisites: To acquire a *Certificate in Science*, with geology as one of the major subjects, a student should have passed 10+2 with science background having either Mathematics/Biology group or equivalent subjects. The candidate may have keen interest in understanding the earth forming processes and its evolution through time.	
PSOs 1	This programme pertains to basic and applied knowledge on the essential components of geology, in which the students will know the broad physical aspects of the earth, and learn toidentify different minerals.
PSOs 2	This programme will impart knowledge on diversebranches of the subject, as well as endogenic and exogenic processes, and geomorphic features of the earth.
PSOs 3	The student will have basic knowledge about the rock forming minerals ,characteristics properties of minerals.
PSOs 4	the subject domain of geology that are required for further academic progression as well as preparation for competitive examinations.

Programme Specific Outcomes (PSOs) ***UG II Year/Diploma Course in Science***	
Programme Specific Prerequisites: To acquire *Diploma in Science*, with geology as one of the major subjects, a student should have obtained Certificate Course in Science from any recognized university.	
PSOs 1	This programme provides broad understanding on various physical and historical aspects of the earth
PSOs 2	Having understood the broad physical aspects of the Earth, its constituents, and rock-forming minerals in the two semester *Certificate of Science* programme, the students will gain knowledge on rock forming processes in one semester, and sequence of rock of the geological past in another semester.
PSOs 3	The programme will enable the students to identify different rocks and rock formingprocesses (petrogenesis) on the basis of minerals, structure, composition, megascopic, and microscopic characters by observing rocks at outcrops, in hand specimens and thin sections

PSOs 4	It will also enable them to identify different succession of rocks on the bases of fossils.

Programme Specific Outcomes (PSOs) ***UG III Year/Bachelor of Science***	
Programme Specific Prerequisites: To acquire a *Bachelor of Science* degree, with geology as one of the major subjects, a student should have obtained Diploma Course in Science from any recognized university. Student should have a learning aptitude towards rocks and ores.	
PSOs 1	Having understood basic physical and historical aspects of the earth as *Diploma in Science* programme, the students of this programme will gain added knowledge on earth resources, environment, geological controls on the safety of civil engineering construction, and evolution of the earth through time
PSOs 2	They will also learn the basics of geochemistry and ecoomic ore and its application potential in geological investigations.
PSOs 3	The programme will enable the students to understand such aspects of the earth as its composition, structure, natural resources, terrain and life evolution through time.
PSOs 4	It will also enable them to identify different types of animal and plant fossils, and to understand the origin and evolution of life on the earth.

Programme specific outcomes (PSOs) **UG IV Year/ Bachelor(Research in Geology)**	
Programme Specific Prerequisites: To acquire *Bachelor (Research) of Science* degree, in Geology, a student should have obtained three year *Bachelor of Science* degree from any recognized university.	
PSOs 1	Under this programme, the students will gain in-depth knowledge on successive advancements in the subject of geology
PSOs 2	Particular focus of this programme is to inculcate in the students the spirit of researching, identifying the knowledge-gaps in the specific corebranches of geology, and motivating them to take up and address such geo-scientific problems in future.

PSOs 3	The programme will enable the students to understand the intricacies of various mineral, rock, and terrain forming processes resulting from spatio-temporal variations underthe prevailing physico-chemical conditions
PSOs 4	Such a knowledge will make them able to locate, explore, and judiciously utilize the Earth's resources, solving the complex geologicalproblems, providing the geo-engineering solutions to sundry geo-environmental problems, including the hazard vulnerability, and safety and stability of civil engineering structures, aswell as fill-up the knowledge-gaps pertaining to core branches of geology.

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.

Number of Seats approved:

B.Sc. PMG: 20

Semester-wise Titles of the Papers in B.Sc.(Geology)						
Year	**Semester**	**Course Code**	**Paper title**	**Theory/ Practical**	**Credits**	**Hours**
Certificate Course in Basic Science						
First Year	I	GELMC101	Physical and Structural Geology	Theory	4	4
		GELMC102	Practical/Lab course	Practical	2	2
	II	GELMC201	Crystallography and Mineralogy	Theory	4	4
		GELMC 202	Practical/Labcourse	Practical	2	4
Diploma Course in Basic Science						
Second Year	III	GELMC 301	Petrology	Theory	4	4
		GELMC 302	Practical/Labcourse	Practical	2	4
	IV	GELMC 401	Stratigraphy	Theory	4	4
		GELMC 402	Practical/Labcourse	Practical	2	2
Bachelor of Science						
Third Year	V	GELMC 501/ GELMC 502 (Any one)	Palaeontology / Geochemistry & Geochronology	Theory	4	4
		GELMC 503/504	Palaeontology Practical/ Geochemistry & Geochronology Practical	Practical	2	4
		GELMC505 F	Field Work	Practical	4	4
	VI	GELMC 601/ GELMC 602 (Any one)	Economic Geology / Sedimentology	Theory	4	4
		GELMC 603/604	Economic Geology Practical/ Sedimentology Practical	Practical	2	4
		GELPR605	Project	Practical	4	4
Bachelor of Science (Research)						
Fourth Year	VII	GELMC 701	Advanced Structural Geology	Theory	4	4
		GELMC 702	Advanced Mineralogy	Theory	4	4
		GELMC 703	Engineering and Disaster Management	Theory	4	4
		GELMC 704	Geological Field	Field Training	4	4

		GELMC 705	Practical/Lab Course	Practical	6	12
		GELMC 706R	Industrial training/Survey/ Research project (With reference to major papers from semester VII)	Practical	4	4
	VIII	GELMC 801	Geotectonics	Theory	4	4
		GELMC C802	Igneous Petrology	Theory	4	4
		GELMC 803	Metamorphic Petrology	Theory	4	4
		GELMC 804	Mineral Exploration and Mining Geology	Theory	4	4
		GELMC 805	Practical/Lab Course	Practical	6	12
		GELMC 806R	Industrial training/Survey/ Research project (With reference to major papers from semester VIII)	Practical	4	4

Year	Semester	Course Code	Paper title	Theory/ Practical	Credits	Hours
MINOR ELECTIVE COURSES(OPEN ELECTIVE)						
First Year	I/II	GELOE001	Geohydrology	Theory	4	4
Second Year	III/IV	GELOE002	Climatology & Oceanography	Theory	4	4
Fourth Year	VII/VIII	GELOE003	Environmental Geology	Theory	4	4

Year	Semester	Course Code	Paper title	Theory/ Practical	Credits	Hours
VOCATIONAL/SKILL ENHANCEMENT COURSES						
First Year	I	GEL VC104	Geological Mapping	Theory	3	3
	II	GEL VC204	Remote Sensing and GIS	Theory	3	3
Second Year	III	GEL VC303	Field geology	Theory	3	3
	IV	GEL VC403	Laboratory techniques in Geology	Theory	3	3

Year	Semester	Course Code	Paper title	Theory/ Practical	Credits	Hours
COMPULSORY/CO-CURRICULAR COURSES						
First Year	I	COCC103	Communication Skills	Theory	0	4
	II	COCC203	Environment Studies and Value Education	Theory	0	4
Second Year	III	COCC305	Management Paradigms From Bhagvad Gita	Theory	0	4
	IV	COCC405	Meditation	Theory	0	4
Third Year	V	COCC506	Vedic Science	Theory	0	4
	VI	COCC606	Essence of Indian Traditional Knowledge	Theory	0	4

Examination Scheme:

Sessional (Internal)	External (ESE)	Total
30	**70**	**100**

Programme Name: B.Sc. Geology

Course code : GELMC101				
Course Name : Physical and Structural Geology				
Semester /Year : I st				
	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. 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 errosion.
CO5	Measure the dip and strike with the help of clinometer compass/brunton.
CO6	Write the concept of unconformity, normal, thrust and slip faults.

Programme Name: B.SC. Geology

Course code : GELMC102				
Course Name : Lab Course based on GELMC101				
Semester /Year : I				
	L	**T**	**P**	**C**
	0	**0**	**4**	**2**

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.

Programme Name: B.Sc. Geology

Course code	**:**	GELOE001			
Course Name	**:**	**Geohydrology**			
Semester /Year	**:**	**I**			
		L	**T**	**P**	**C**
		2	**0**	**0**	**2**

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 hydrology.

2. To teach the vertical distribution of groundwater, Surface and subsurface geophysical and geological methods of groundwater.

Course Contents

Unit I: Introduction and scope of hydrology. Hydrologic cycle and its components: precipitation, evapo-transpiration, run-off, infiltration and sub-surface movement of water. Vertical distribution of sub-surface water.

Unit II: Origin of groundwater, Water bearing and yielding bodies, Types of Aquifers.

Unit III: Aquifers and their types. Darcy's Law and its validity, Dupuit's assumptions, Base flow equation. Surface and sub-surface water interaction.

Unit IV: Surface and subsurface geophysical and geological methods of ground water exploration; Ground water resources of Uttrakhand**.**

Text Books:

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

Reference Books:

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

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

CO1	Learn and Gain knowledge of basic principles of Hydrology, Hydrological cycle, hydrological parameters, origin of earth, geophysical and geological methods of groundwater.

CO2	Understand the Hydrological cycle, origin of groundwater, geophysical methods.
CO3	Explain the water bearing properties of rocks, vertical distribution of groundwater.
CO4	Analyze the concept of surface and subsurface water flow.
CO5	Distinguish between among Aquifers.
CO6	Derive the Darcy's Law, write about geophysical methods, groundwater conditions.

Programme Name: B.Sc. Geology

Course code : GEL VC104				
Course Name : Geological Mapping				
Semester /Year : I				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

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

Course Objectives: The objective 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.

Unit II: Studying the geologic maps, understanding the interaction between topography and geologic structures.

Unit III: Basics of field data collection, analyses, interpretation, and geological report writing.

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, 2nd 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.

Programme Name: B.Sc. Geology

Course code : GELMC201				
Course Name : Crystallography and Mineralogy				
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

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

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

Mineralogy

Unit 1 Common physical properties of minerals (form, colour, luster, streak, cleavage, fracture, hardness, and specific gravity), Chemical composition and diagnostic physical properties of silica, feldspar, amphibole, pyroxene, olivine, feldsphathoid, 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]

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.CBSPubl.

TB3 Nesse, D.W.,1986. Optical Mineralogy.McGrawHill.

Reference Books:

RB1 Read, H.H., 1968.Rutley'sElement of Mineralogy (Rev. Ed.). Thomas Murbyand Co.
RB2 Berry and Mason,1961. Mineralogy.W.H. Freeman & Co.
RB3 Kerr, B.F.,1995.Optical Mineralogy5thEd. McGraw Hill, NewYork.

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 f normal classes of common crystal.
CO3	Differentiate different crystal systems on the basis of symmetry and other properties of crystal and minerals, laws of twinning.
CO4	Measure interfacial angle by using contact goniometer, give different notations in crystal, Explain properties of minerals, Crystallographic axes.
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 and twinning.

Programme Name: B.Sc Geology

Course code : GELMC 202				
Course Name : Lab Course based on GELMC201				
Semester /Year : II				
	L	**T**	**P**	**C**
	0	**0**	**4**	**2**

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

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.

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

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

Programme Name: B.Sc. Geology

Course code	**:**	GEL VC204			
Course Name	**:**	**Remote Sensing and GIS**			
Semester /Year	**:**	**III**			
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

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 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 : Siegel, 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

CO1	Learn and Gain Knowledge of Remote sensing and GIS.
CO2	To understand the interpretation of photography, component of GIS, Digital Image processing.
CO3	Use of Remote Sensing in various field, Explain the concept of aerial photography, camera, tools used in GIS.
CO4	Analyze various physiographical features through GIS , Explain factors affecting aerial photography; types of camera.

CO5	Evaluate the data with the help of satellites, concept of image classification.
CO6	Write the GIS concept, remote sensing sensor.

Programme Name: B.Sc. Geology

Course code : GELMC 301				
Course Name : Petrology				
Semester /Year : III				
	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 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 and 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. McGraw Hill Co.

TB2 : Prasad, C.,1980.Atext book of sedimentology

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

Reference Books:

RB1: Pettijohn,F.J.,1975.Sedimentary rocks, Harper &Bros.3rdEd.

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

CO1	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.
CO2	Understand the formation , , texture, structure of Igneous rock, Sedimentary rock and Metamorphic rock.
CO3	Explain the use of Petrography of Igneous , Sedimentary and Metamorphic rock, different structures of rocks, types of Metaomorphism.
CO4	Classify the Igneous rock, Sedimentary rock and Metamorphic rock, Crystallization of uni-component and bi-component (mix-crystals); Bowen's reaction principle, Petrography of rocks.

CO5	Distinguish between different type of rocks.
CO6	Write the process of metamorphism, agents of metamorphism, petrography of metamorphic rock, facies concept.

Programme Name: B.Sc. Geology

Course code : GELMC 302				
Course Name : Lab Course based on GELMC 301				
Semester /Year : III				
	L	**T**	**P**	**C**
	0	**0**	**4**	**2**

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 hand specimen.

Programme Name: B.Sc. Geology

Course code	**:**	**GEL VC303**			
Course Name	:	Field geology			
Semester /Year	**:**	**III**			
		L	**T**	**P**	**C**
			0	**0**	**3**

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

The paper will be based on training on geological field, and various instruments used in geological analysis. During fieldwork the students will be exposed to terrains of different geological characteristics, different types of mines, natural resource exploration sites, various types of geohazard sites. Students will prepare geological reports on the basis of their training, which will be evaluated for the marking.

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, 2nd ed., John Wiley & Sons Ltd, New Delhi.

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

Course

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

Programme Name: B.SC. Geology

Course code	**:**	GELMC 401			
Course Name	**:**	Stratigraphy			
Semester /Year	**:**	**IV**			
		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. 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

Unit I: Definition, types of stratigraphy; Geological time scale and stratigraphic classification; Physiographic division of India.

Unit II: Study of following Precambrian succession: Dharwar, Rajasthan, Singhbhum, Cuddapha, Vindhyan and Mesozoic type succession of Kutch and Cretaceous of Tiruchirapalli.

Unit III: Gondwana: classification and importance of lower Gondwanaland Deccan Trap, stratigraphy of lesser himalayas & higher tethyan Himalayas.

Unit IV: Cenozoic (Palaeogene-Neogene) sequences of Himalaya and Assam.

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, Physiographic division of India, succession of Gondwana, Mesozoic, Siwalik.
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.

Programme Name: B.Sc. Geology

Course code : GELMC 402				
Course Name : Lab Course Based on GELMC 401				
Semester /Year : IV				
	L	**T**	**P**	**C**
	0	**0**	**4**	**2**

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

Programme Name: B.Sc. Geology

Course code : GEL VC403				
Course Name : Laboratory techniques in Geology				
Semester /Year : IV				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

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

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

[No. of Hours: 20]

UnitII: 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: 30]**

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, 2nd 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

Programme Name: B.Sc. Geology

Course code	**:**	**GELMC 501**			
Course Name	:	**Palaeontology**			
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 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: 14]**

Unit 2 Elementary ideas about origin of life and adaptation to various environments. Systematic classification of organisms. **[No. of Hours: 10]**

Unit 3 Invertebrate Paleontology- Morphology, classification, evolutionary trends, and geological distribution of Brachiopods, Lamellibranches, Gastropods , Cephalopods, and Trilobites**.** **[No. of Hours: 14]**

Unit 4 Vertebrate Paleontology: Introduction of Siwalik vertebrate fauna, evolutionary history of Equidae, Proboscidea and Hominidae**.** **[No. of Hours: 13]**

Unit 5 : Introduction to Paleobotany; fossil record of plants through time; Gondwana Flora.

[No. of Hours: 09]

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

CO1	Learn and gain Knowledge of fossils, conditions and modes for fossilization**,** Invertebrate, vertebrate Paleontology, paleobotany and Micropaleontology.
CO2	To understand the morphology of the hard parts of different phylum's and geological time range.
CO3	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.
CO4	Explain the condition of fossilization and significance of fossils, classification of organisms. Distinguish between different phyllum.
CO5	Distinguish between the Upper Gondwana and Lower Gondwana**,**
CO6	Write the collection techniques of fossils, mode of preservation, types of fossils.

Programme Name: B.SC. Geology

Course code	**:**	GELMC 503			
Course Name	**:**	**Lab Course based on GELMC 501**			
Semester /Year	**:**	**V**			
		L	**T**	**P**	**C**
		0	**0**	**4**	**2**

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

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

Programme Name: B.SC. Geology

Course code	**:**	**GELMC 502**			
Course Name	**:**	**Geochemistry and Geochronology**			
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.This course is designed to understand high-T and low-T geochemical processes that operate in the earth's deeper and near-surface environments

2. The major task of geochemists is to know the physical and chemical laws governing the abundance, distribution and migration of chemical elements from one sphere to another sphere of the Earth i.e. chemical differentiation of the Earth

Content

Unit I: Composition of Earth and its constituents (Crust, mantleand core); Ionic and co-ordination number; Rules of ionicsubstitution, coupled substitution; Distribution coefficient: Capture admission and camouflage, Geochemical classification of elements; Behaviour of major and trace including rare earth elements during magmatic crystallization.

Unit II: Near-Earth surface geochemical environment: Eh-pHdiagram; Principle of chemical mass balance and rock- cycle; Chemical weathering of minerals and rocks.

UnitIII: Radiogenic isotopes in geochronology and petrogenesis: Rb-Sr, Sm-Nd, U-Pb isotopic system.

Unit IV: Stable isotopes geochemistry, Fission Track (FT) and OSL dating techniques; Dendrochronology andLichenometry.

Text Books:

TB1: Allegre, C.J. and Michard,G. (1974). Introduction to Geochemistry, Reidel, Holland.

TB2: Evans, R.C.(1964). Introduction to Crystal Chemistry, Cambridge Univ.Press.

Reference Books:

RB1: Faure,G.(1986). Principles of Isotope Geology, 2nd Edn., John Wiley.

RB2: Misra, K.C.(2012).Introduction to Geochemistry: Principles and Applications,Wiley-Blackwell.

Course outcomes (COs):

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

CO1	Learn and Gain Knowledge of the basic concept of the Geochemistry and Geochronology, Structure of earth ,geochemistry of earth, , geochemical behaviour of different elements, Radiogenic isotopes, Stable isotopes geochemistry.
CO2	Discuss the geochemical classification of elements, Major, minor and trace and elements.
CO3	Explain element partitioning in minerals and rocks. and Radiactive isotopes.

CO4	Idea about Fission Track (FT) and OSL dating techniques; Dendrochronology andLichenometry
CO5	Distinguish between the different Layer of Earth, chemical weathering of mineral and rocks.
CO6	Write the chemical composition characteristics of the Earth,

Programme Name: B.Sc. Geology

Course code	GELMC 504			
Course Name	**: Lab Course based on GELMC 502**			
Semester /Year	**: V**			
	L	**T**	**P**	**C**
	0	**0**	**4**	**2**

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

Geochemistry & Geochronology: Construction ofgeochemical variation diagrams

(Spiderdiagrams; Harker's variation diagrams; addition-substraction diagrams);

Calculation of stoichriometric formula from chemical analysis of minerals.

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

CO1	Gain Practical Knowledge of Construction ofgeochemical variation diagrams.
CO2	Understand the Practical Concept of PH.

CO3	Determine the geochemical variation diagrams.
CO4	Analyzing the techniques used in geochemical analysis.
CO5	Evaluate the result..
CO6	Solve the problems based on given data.

Programme Name: B.SC. Geology

Course code : GELMC505F				
Course Name : Field Work				
Semester /Year : **V**				
	L	**T**	**P**	**C**
	0	**0**	**4**	**4**

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

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.

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

Programme Name: B.Sc. Geology

Course code : GELMC 601				
Course Name : Economic Geology				
Semester /Year : VI				
	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. The student is introduced to the basic principles of Economic geology.

2. To learn about the hydrological cycle, origin of ground water and groundwater exploration methods.

Course Contents

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:10]

Unit 2 Processes of formation of ore deposits; Magmatic, Mechanical and residual concentration, contact metasomatic, hydrothermal, sedimentation, oxidation, supergene enrichment. **[No. of Hours:20]**

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: 15]

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

[No. of Hours: 15]

Text Books:

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

TB2 :Umeshwar Prasad, 2003. Economic Geology.CBS Publishers and distributors.

Reference Books:

RB1: Krishnnaswamy, S., 1979.India's Minerals Resources. Oxford and IBH Publ.

RB2: 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

CO1	Learn and Gain knowledge of basic principles of economic geology, Processes of formation of ore deposits, metallic minerals, coal ,petroleum.
CO2	Understand the economic value of the ores.
CO3	Explain the formation of ore deposits and coal and petroleum in India
CO4	Analyze Demand and supply of ores and Mineral conservation.
CO5	Distinguish between various ore deposits of India.
CO6	Write the concept of metallic and non metallic minerals.

Programme Name: B.Sc. Geology

Course code : GELMC 603				
Course Name : Lab Course based on GELMC 601				
Semester /Year : VI				
	L	**T**	**P**	**C**
	0	**0**	**4**	**2**

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 prepration of Ore map.

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.

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

CO1	Gain Knowledge samples of ore deposits.
CO2	Understand the distribution of minerals in India.
CO3	Prepare of maps showing distribution of important metallic and non-metallic deposits in India.
CO4	Analyze the samples of economic minerals.
CO5	Compare the different ore minerals.
CO6	Prepare the map of showing important coal and oil fields of India.

Programme Name: B.Sc. Geology

Course code : GELMC 602				
Course Name : Sedimentology				
Semester /Year : VI				
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

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

Course Objectives: The objectives of this course are The course in-depth knowledge about the types and origin of sedimentary rocks, and source-to-sink sedimentary processes. It emphasizes upon the modern concepts of palaeo environmental analysis, as well as provenance determination of sedimentary rocks. The course content deals with all the essential aspects required in exploring oil and natural gas, underground water, mechanically concentrated mineral deposits (placer deposits), and building stones

Course Contents

Unit I: Sedimentary texture, and textural parameters and their significance. Textural and compositional maturity. Fluid flow concepts, sediment transport, bedforms and sedimentary structures. Allogenic and autogenic controls on sedimentation. Palaeocurrent analysis and its significance. **[No. of Hours:15]**

Unit II: Concept of sedimentary facies, facies associations, and facies model. Characteristics, processes, and facies of fluvial, lacustrine, deltaic, esturine, tidal flat, lagoonal, barrier beach, and deep-sea sedimentary environments. Tectonic classification of sedimentary basins. .

[No. of Hours:15]

Unit III: Types and petrogenesis of conglomerates, sandstones, and argillites. Problem of greywacke. plate tectonics and sandstone composition. Classification and genesis of limestones and dolomites. Evaporites: Gypsum and anhydrite. **[No. of Hours:10]**

Unit IV: Digenesis – Physical and chemical processes. Diagenetic stages and regimes Evidences of diagenesis in sandstones, mud rocks and carbonate rocks. Provenance of sedimentary rocks. Provenance identification of sandstones through petrographic, petrofacies, and heavy mineral analyses.

[No. of Hours:15]

Text Books:

TB1: Blatt, H., Middleton, G.V. and Murray, R.C. (1980). Origin of sedimentary rocks. Prentice Hall Inc.
TB2: Collins, J.D. and Thompson, D.B. (1982). Sedimentary structures. George Allen and Unwin, London

Reference Books:

RB1 :. Pettijohn, F.J. (1975). Sedimentary rocks (3rd Ed), Harper and Row Publ., New Delhi.
RB2 :. Lindholm, R.C. (1987). A practical approach to sedimentology. Allen and Unwin, London

Course outcomes (COs):

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

CO1	Gain knowledge about the types and origin of sedimentary rocks, and

	source-to-sink sedimentary processes, facies, petrography.
CO2	Understand the modern conceptsof palaeo environmental analysis, as well as provenance determination of sedimentary rocks, sedimentary texture.
CO3	Apply the petrography detail on the identification of sandstone, sedimentary facies concept identification of environment.
CO4	Differentiate among limestones and dolomites. Evaporites: Gypsum and anhydrite, Allogenic and autogenic controls on sedimentation.
CO5	On the bases of environment measures different facies, structures and texture.
CO6	Write the concept of Palaeocurrent analysis and its significance, Digenesis process.

Programme Name: B.Sc. Geology

Course code : GELMC 604				
Course Name : Lab Course based on GELMC 602				
Semester /Year : VI				
	L	**T**	**P**	**C**
	0	**0**	**4**	**2**

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

Course Objectives: The objectives of this course are

1. The course in-depth knowledge about the types and origin of sedimentary rocks.
2. Study the Petrography detail of rocks.
3. Study the facies models.

Course Content: [No. of Hours:60]

Detailed study of clastic and nonclastic rocks in hand specimen. Study of sedimentary structures hand specimen in form-process context. Petrography of important rock types with emphasis on depositional setting, provenance and diagenesis. Heavy mineral identification with regard to their significance in provenance interpretation. Study of important facies models.

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 important facies models.
CO2	Compare different type of rocks in hand specimen.
CO3	Prepare the slides of different types of rocks.
CO4	Distinguish the rock in microscopic and macroscopic level.
CO5	Analyze the thin section of Sedimentary rock.
CO6	Write the Physical properties of rocks in hand specimen.

Programme Name: B.Sc. Geology

Course code : GELMC 701				
Course Name : Advanced Structural Geology				
Semester /Year : VII				
	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. The present course will teach the student how to unravel the underlying deformation processes and mechanisms through an accurate geometric and kinematic analysis of these natural structures.

2. The present course will teach the dynamic instability of the lithosphere, continuous and discontinuous deformation takes place within the rocks in solid or semi-solid state, at different scales, which manifests in a variety of complex structures in these rocks.

Course Contents

Unit I: Concept of stress and strain. Stress-strain relationships of elastic, plastic and viscous materials. Two dimensional strain and stress analyses. Types of strain ellipses and ellipsoids; their properties and significance. Mechanical principles and properties of rocks and their controlling factors. Theory of rock failure; brittle and ductile deformation, Mohr's circle.

[No. of Hours:15]

Unit II: Mechanics of folding and buckling. Folds geometry and classification. Superimposed folds and their interference patterns. Analytical methods of determining fold style. Causes and dynamics of faulting. Normal faults and strike – slip faults. Overthrust and nappe with implications to thrust tectonics. Salt domes and diapers. **[No. of Hours:15]**

Unit III: Joints, rock cleavage and foliations; their origin, domain character, relationship with major structures and geological significance. Transposed foliations. Linear structures and boudinage; their origin, relationship with major structures and significance. Deformation of linear structures. **[No. of Hours:15]**

Unit IV: Brittle and ductile shear zones; their geometry, strain pattern, kinematics and significance. Rotation of structural elements. Concept of petrofabric analysis. Use of stereographic and equal area projections for representing different types of fabric.

[No. of Hours:15]

Text Books:

TB1: Ghosh,S.K.:StructuralGeology,FundamentalandModernConcepts,PergamonPress.

TB2: Ramsay J.G.(1967):Folding and fracturing of Rocks, Mc Graw Hill Pub.

TB3: RamsayJ.G.&HuberM.I.(1983):TheTechniquesofModernStructuralGeology-I,Strain Analysis, Academic Press.

Reference Books:

RB1: Turner,F.J.&Weiss,L.E.(1963):StructuralanalysisofMetamorphicTectonites,McGrawHill publ.

RB2: Jain, A,K, advance structural analysis, Nem chand and bros.

Course outcomes (COs):

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

CO1	To gain the knowledge and accurate geometric description of the structures observed in natural deformed rocks.
CO2	To understand and measurement of various orientation data from the structures, plotting them in suitable diagrams and make a quantitative analysis, concept of fold.

CO3	To apply the basic knowledge on the concepts the Mechanics of folding and buckling and fault.
CO4	To analyze the deformation mechanisms at micro-, meso and macroscopic scales, joint, unconformity, lineation and foliation.
CO5	To estimate the stresses when rocks goes under the deformation by using Mohr's circle.
CO6	To reconstruct their deformational histories and estimate the stress field that resulted in that deformation, write the concept of petrofabric analysis.

Programme Name: B.SC. Geology

Course code : GELMC 702				
Course Name : Advanced Mineralogy				
Semester /Year : VII				
	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.The present course will teach the characteristics of major rock forming mineral groups,crystal symmetry, and crystallography axis.
2.The present course will teach the atomic structure, formation environments and associations of rock-forming minerals.

3. The present course will teach the techniques of mineral characterization.

Content

Unit 1: Structural classification of silicates; Study of following group of minerals with reference to chemical and structural formula, classification, atomic structure, chemistry, physical and optical properties, occurrences: Olivine, Garnet, Pyroxene, Amphibole, Mica, Feldspars, Feldspathoids, Silica and Al silicates. **[No. of Hours:15]**

Unit II: Formation of Uni-axial and Bi-axial interference figures, Interference colors, Pleochroism and determination of pleochroic scheme, Interference figures and determination of optic sign; Extinction; Uniaxial and Biaxial indicatrix and dispersion in minerals.

[No. of Hours:15]

Unit III: Petrographical microscope; Mica, Gypsum and Quartz plates; Universal stage and their uses in the determination of optical properties of minerals. **[No. of Hours:15]**

Unit IV: Application of spectroscopic techniques in mineralogy-Raman and Mossbauer spectroscopy, An overview of environmental and radiation mineralogy; biomineralization and gemology. **[No. of Hours:15]**

Text Books:

TB1: Moorhouse,W.W.:Optical Mineralogy.

TB2: Dana,E.S. &Ford,W.E.:ATextbook of Mineralogy, Wiley Eastern Ltd.

TB3: Phillips, W.R & Guffen, D.T-Optical mineralogy.

TB4: Barry &Mason- Mineralogy.

Reference Books:

RB1: Dexterperkin, optical mineralogy.

RB2: Alexander N.winchill, element of Optical Mineralogy,ulan press pub.

RB3: Babu. S. Kandsinha. D.K ,mineralogy, CBS pub.

Course outcomes (COs):

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

CO1	Learn and Gain knowledge of silicates mineral ,non silicates, properties of minerals, different silicate structure, uniaxial and biaxial crystal, Petrographical microscope.
CO2	This course will provide a better understanding on natural occurrence, identification, structure, and genesis of silicate and non-silicate minerals, and their applications in different fields.
CO3	Explain structure of silicates, groups of various minerals.
CO4	Classify Silicate, and Explain the different Petrographical microscope properties of minerals.
CO5	. Distinguish among different Uni-axial and Bi-axial properties of minerals.
CO6	Express the views on Application of spectroscopic techniques in mineralogy-Raman and Mossbauer spectroscopy, Petrographical microscope.

Programme Name: B.Sc. Geology

Course code	**:**	GELMC 703
Course Name	**:**	Engineering and Disaster Management

Semester /Year : VII				
	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 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 I: Engineering properties of rocks and Soils**.** **[No. of Hours:07]**

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

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

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

Unit V: 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]**

Unit VI: 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 VII: 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 VIII : 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

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

Programme Name: B.SC. Geology

Course code : GELMC 704F				
Course Name : Geological Field				
Semester /Year : V				
	L	**T**	**P**	**C**
	0	**0**	**4**	**4**

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 Content:

Students will be required to visit geologically important areas including mines, dams, oilfields, fossiliferous sequences and laboratories/institutes of repute and submit a report thereon, under the supervision of a faculty member.

Text Books:

TB1: Mathur S.M., Guide To Field Geology

TB2: Gokhale N.W., A Guide to Field Geology

Reference Books:

RB1: Mathur S.M., Guide To Field Geology

RB2: Gokhale N.W., A Guide to Field Geology

Course outcomes (COs):

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

CO1	The course is intended to expose students to any economic deposit, familiarize them about host rock and economic mineral relationship, variable geometry of ore bodies.
CO2	To understand the planning of exploration and exploitation, Open and/or underground mine section.
CO3	To apply the knowledge of geology to identify the structures and microstructures in the field
CO4	To analyze the fundamentals work on the field.
CO5	To estimate the collected data from the field.
CO6	To develop skills for the writing of the tour report.

Programme Name: B.SC. Geology

Course code : GELMC 705				
Course Name : Lab Course based on GELMC 705				
Semester /Year : VII				
	L	**T**	**P**	**C**
	0	**0**	**4**	**4**

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

Course Objectives: The objectives of this course are

1. To learn about the deformation of rock in hand specimen.

2. To learn about the optical properties of minerals.

3. to learn about the Engineering problems.

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

Study of naturally deformed rocks in hand specimens, Geometrical analysis of folds and faults. Preparation and interpretation of geological maps, Applications of stereographic and equal area projections.

Identification of common rock forming minerals based on optical properties
Engineering properties and identification of building stones.

Identification of various models of landslide, tunnel and dam.

Hazard zonation map of India: ,earthquakes, floods droughts, landslides

Text Book

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

TB2: Sethi, V. K., 2009, Disaster Management, Essential Books PW, New Delhi

Course outcomes (COs):

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

CO1	Gain Knowledge Preparation of engineering geological maps
CO2	Explain the model of tunnel.
CO3	Explain the model of dam.
CO4	Analyze the rock samples.
CO5	Distinguish between different rocks on the basis of Engineering properties.
CO6	Solve the problem based on landslide, earthquake, floods.

Programme Name: B.SC. Geology

Course code	**:** GELMC 801				
Course Name	**:** Geotectonics				
Semester /Year	**:** VIII				
		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. The objective of this course is to understand the basic concept of continental drift and supporting evidences, Geomagnetic fields, palaeomagnatism, polar wander, geomagnetic pole reversal, sea floor spreading.

2. The objective of this course is to understand the basic concept of Plate boundaries, plate motion and dynamics.

3. The objective of this course is to understand the basic concept of Relative plate motion -geodetic measurement, seismology, internal structure of the earth and to understand the geodynamics of Indian plate and evolution of Himalayas

Course Content:

Unit1:-Evidenceofcontinentaldrift,mechanics,objectionsandpresentstatus,Conceptof Plate Tectonics. **[No. of Hours:10]**

Unit2:-Majortectonicfeaturesoftheoceanicandcontinentalcrust,islandarcs,oceanicislands and volcanic arcs, Gravity and magnetic anomalies at mid oceanic ridges, Origin and significance of Mid-Oceanic Ridges and Trenches. **[No. of Hours:20]**

Unit3:-Seismicbeltsoftheearth&seismicityandmountainchains,theirglobaldistribution and evolution. **[No. of Hours:15]**

Unit4:- Sea floor spreading, Palaeo-magnetism, Polar Wandering and reversal of earth's magnetic field. **[No. of Hours:15]**

Text Books:

TB1: CondieKent,C.(1989):PlateTectonicsandCrustalEvolution.

TB2: W.J.Kious&Robert I.T.:ThisdynamicofEarth:thestoryofPlateTectonicsUSGS publ.

TB3: Moores,E.&Twiss,R.J.,1995:Tectonics.Freemanpubl.

Reference Books:

RB1: Keary,P.&Vine,F.J.1990:GlobalTectonics.Blackwellscientificpubl.

RB2: Storetvedt,K.N.1997:OurEvolvingPlanet.EarthHistoryinnewperspective.

RB3: Valdiya,K.S.1998:DynamicsHimalaya.Univ.Press.

Course outcomes (COs):

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

CO1	To gain the knowledge of the dynamic nature of the Earth processes.

CO2	To understand about the geodynamics of the lithosphere and concept of isostasy, ocean floor spreading, continental drift, plate tectonics.
CO3	To classify the present geophysical and geological evidence for the processes operating in modern tectonic systems.
CO4	Distinguished between the major continental features and oceanic features and other tectonic features.
CO5	Explain about the seismicity and their global distribution on earths.
CO6	Write about the Palaeo magnetism and paleo magnetic maps , polar wandering curve and sea floor spreading.

Course code : GELMC C802				
Course Name : Igneous Petrology				
Semester /Year : VIII				
	L	**T**	**P**	**C**
	4			**4**

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

Course Objectives: The objectives of this course are

1. This is an introductory course to provide a basic understanding of the different groups of igneous rocks and the processes involved in their formation.

2. This course starts with the chemistry and physics of melts and their behavior under varying temperature and pressure conditions, and goes on to discuss the different kinds of igneous rocks and rock suites that form under different tectonic conditions.

3. The focus broadens to the formation of the solar system, the Earth, and the elements themselves. Then the composition of the Earth itself becomes the topic, examining the composition of the core, the mantle, and the crust and exploring how this structure originated.

Course content:

Unit 1:- Magma generation in the mantle, the irnature and evolution; Magmatic processes: Partial melting, fractional crystallization, magma mixing, assimilation, liquid immiscibility, and other subsidiary processes. . **[No. of Hours:15]** .

Unit 2:-Petrography and genetic interpretation of igneous textures in terms of rate of nucleation and crystal growth; IUGS classification schemes and nomenclature of igneous rocks: Ultramafic, mafic and felsic igneous rocks; total-alkali-silica(TAS) classification of volcanic igneous rocks. . **[No. of Hours:15]**

Unit 3:-Study of phase equilibria in binary (Diopside-Anorthite,Forsterite-Silica,Nepheline-Silica,Forsterite-Fayalite;Albite-Anorthite; Orthoclase-Albite) and ternary (Diopside-Nepheline-Silica,Diopside-Albite-Anorthite,Anorthite-Forsterite-Silica;Fayalite-Leucite-Silica, Orthoclase-Albite-Silica) silicate systems in the light of modern experimentalworks.

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

Unit 4:-Petrogenesis and tectonic setting of major igneous rock types and suites: Ultramafic rocks, komatiite, lamprophyres, kimberlite, ophiolite, floodbasalt, anorthosite, Tonalite-Trondhjemite-Granodiorite(TTG),granitoids, alkaline rocks and carbonatites with special reference to Indian examples. . **[No. of Hours:15]**

Text Books:

TB1: Gupta,A.K.(1998): Igneous Rocks Allied Publishers Ltd., New Delhi.

TB2: Jackson: Textbook of lithology.

TB3.:Winter,J.D.(2001):AnIntroductiontoIgneousandMetamorphicPetrology

TB4: McBirney,A.R.(1984):IgneousPetrology,FreemanCooper&Co.California.

TB5:PhillpotsA.:Introductiontoigneousandmetamorphicpetrology,PrenticeHallPub.

Reference Books:

RB1: Turner, F.J. & Verhoogen, J.: Igneous &Metamorphic petrology CBS Publications.

RB2: Bose, M.K.(1997):Igneous Petrology, World Press, Kolkata.

RB3: Best,MyronG.(2002):IgneousandMetamorphicPetrology,BlackwellScience.

Course outcomes (COs):

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

CO1	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.
CO2	Understand the formation, texture, structure of Igneous rocks.

CO3	Explain the use of Petrography of Igneous rocks.
CO4	Classify the Igneous rock, Crystallization of uni-component and bi-component (mix-crystals); Bowen's reaction principle.
CO5	Distinguish between different types of igneous rocks.
CO6	Write the process of magmatism, petrography of igneous rock.

Programme Name: B.Sc. Geology

Course code : GELMC803				
Course Name : Metamorphic Petrology				
Semester /Year : VIII				
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

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

Course Objectives: The objectives of this course are

The study of metamorphic rocks encompass the chemical and physical transformations that take place in response to changing pressure, temperature, and chemical environments in the Earth's interior. In this course, different petro genetic processes involving mineral reactions will be explored using equilibrium thermodynamics.

Course content:

Unit I: Mineralogical Phase rule of open and closed systems; Types of metamorphism;Textures of regional and contact metamorphic rocks; Deformation and metamorphism; Natureand types of metamorphic reactions; Concept and classification of metamorphic facies; Facies series;Graphical representation of minerals in ACF, AKF, AFM. and A'F'M' diagrams. . **[No. of Hours:20]**

Unit II Description of each facies of low pressure, medium to high pressure and very high pressure with special reference to characteristics minerals, subdivisions into zones / sub-facies, mineral assemblages, metamorphic reactions and pressure temperature conditions of metamorphism. Introduction to Ultra-high temperature and Ultra-high pressure metamorphism. Metamorphism of shale, mafic andcalcareous rocks. . **[No. of Hours:20]**

Unit III: Isograds and Reaction Isograds, Metamorphicdifferentiation; Anatexis and origin of migmatites; Paired metamorphic belts. . **[No. of Hours:10]**

Unit IV: Graphical representation of minerals in ACF, AKF, AFM and AFM diagrams; Time relation between phases of Deformation and metamorphic crystallization.

[No. of Hours:10]

Text Books

TB1. Winter,J.D.(2001):AnIntroductiontoIgneousandMetamorphicPetrologyNew York.

TB2. Bucher,k.andMartin,F.2002:PetrogenesisofMetamorphicRocks,Springer-Verlag,7th Revised Edition.

Reference Books:

RB1. Yardley,B.W.D.1989:AnIntroductiontoMetamorphicpetrology,Longmanscientific &Technical, New York.

RB2. Spry,A.1976:MetamorphicTexture,PergamonPress.

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

CO1	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.
CO2	Understand the formation, texture, structure of Metamorphic rock.
CO3	Explain the use of Petrography of Metamorphic rock.
CO4	Classify the Metamorphic rock.
CO5	Distinguish between different types of rocks.
CO6	Write the process of metamorphism, agents of metamorphism, petrography of metamorphic rock.

Programme Name: B.SC. Geology

Course code	**:** GELMC804				
Course Name	**:** Mineral Exploration and Mining Geology				
Semester /Year	**:** VIII				
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

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

Course Objectives: The objectives of this course are

Exploration is a range of activities to help determine if there are minerals under the ground. If the exploration process identifies minerals can be commercially extracted, then mining in the future may be possible. Less than one per cent of exploration projects typically progress to establishing a mine. Geology is the first step in mining and involves identifying prospective mineral deposits that might become mines. Geology also helps mine managers know where to develop once the mine is up and running.

Course Content:

Unit1:-Prospectingforeconomicminerals,samplingassayingandevaluationofmineral deposits, geological and geo-botanical techniques of prospecting . . **[No. of Hours:10]**

Unit 2:-Gravity method:principle of gravimeters, gravity field surveys, various types of corrections applied to gravity data, Resistivity method: basic principles, various types of electrodeconfiguration,fieldprocedure:profilingandsoundingandmagnetic,seismicand radioactive methods. . **[No. of Hours:2 0]**

Unit3:-Briefoutlineofwell-loggingtechniquesandtheirmethods,Drillingandtypeofdrilling methods, Application of remote sensing in mineral exploration. **[No. of Hours:15]**

Unit 4:-Planning, exploration and exploratory mining of surface and underground mineral depositsinvolveshaftsinking,drifting,crosscutting,winzing,stopping,roomandpillaring,top-slicing, sub caves and block caving and mining Hazards. **[No. of Hours:15]**

Text Books:

TB1. Sinha, R.K. & Sharma, N.L.(1976):Mineral Economics.

TB2. Arogyaswami, R.N.P.(1996): Courses in Mining Geology

Reference Books:

RB1. P.K. Banerjee and S. Ghosh (1997):Elements of prospecting for non-fuel mineral deposits.

RB2. Bagchi, T.C., Sengupta, D.K. & Rao, S.L.V.N.(1979):Elements of Prospecting and Exploration.

Course outcomes (COs):

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

CO1	To understand the knowledge of selected ore deposit types, including genesis and exploration requirements.
CO2	To understand the prospecting methods and sampling methods and assaying
CO3	To classify the exploration methods and Geochemical & Geobotanical exploration methods
CO4	To differentiate the geophysical methods eg:- gravity, magnetic and seismic methods etc.
CO5	To distinguished between the surface mining methods and underground mining methods
CO6	Write about the mining processes and mining hazards and their impact

Programme Name: B.Sc. Geology

Course code	**:** GELMC805				
Course Name	**:** Practical/Lab Course				
Semester /Year	**:** VIII				
		L	**T**	**P**	**C**
		0	**0**	**6**	**6**

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

Course Objectives: The objectives of this course are

1. This course will provide the basic understanding of stereographic projection by using the field data.

2-The aim of this course is to understand how igneous rocks are classified based on the mineralogy and textures and how these can be used to interpret their cooling history. Upon completion of this course, the student will be able to identify igneous rocks and explain the processes by which the rock formed based on the textural associations of the mineral assemblages.

3-Graphic construction of ACF, AKF and AFM diagrams.

4-Upon completion of this course, the student will be able to **p**reparation of mineral maps of India, calculation of grade and ore reserves etc.

Course Content

Unit1- Geotectonics Stereographic present at ionofstructural data

Unit2-IgneousPetrology

Megascopicstudyofdifferenttypesofigneous rocks.

Microscopicstudyofimportantigneousrocks.

PlottingofmodaldataisIUGS diagram.

Unit3- MetamorphicPetrology

Studyof sedimentaryand metamorphicrocks inhand specimen.

GraphicconstructionofACF,AKFandAFMdiagrams.

Unit4- MineralExplorationandMiningGeology

PreparationofmineralmapsofIndia.

Graphical representationofproduction,exportandimportofimportant minerals.

Calculationofgrade andore reserves.

Interpretationofremotesensingdataformineralexploration.

Text Books:

TB1.W.S. Mackenzie, C. Guilford, Atlas of the Rock-Forming Minerals in Thin Section

TB2. Practical Handbook of Earth Science by Jane H. Hodgkinson; Frank D. Stacey, CRC Press

TB3. Practical Geology, Dr. Harish Kapasya, Himanshu Publications

Reference Books:

RB1.W.S. Mackenzie, C. Guilford, Atlas of the Rock-Forming Minerals in Thin Section

RB2. Practical Handbook of Earth Science by Jane H. Hodgkinson; Frank D. Stacey, CRC Press

RB3. Practical Geology, Dr. Harish Kapasya, Himanshu Publications

Course outcomes (COs):

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

CO1	To the knowledge of different rock type.
CO2	To understand the rock properties in hand specimen and identify them.
CO3	To classify the rocks on the basis of physical properties of Igneous, Sedimentary and metamorphic.
CO4	To analyses optical properties of thin section in the microscope
CO5	To estimate and Calculation of grade and ore reserves. Stereographic presentation of structural data.
CO6	Graphic construction of ACF, AKF and AFM diagrams.

Programme Name: B.SC. Geology

Course code	**:** GELMC 806R				
Course Name	**:** Industrial training/Survey/ Research project/Dissertation				
Semester /Year	**:** VIII				
		L	**T**	**P**	**C**
				4	**4**

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

Course Objectives: The objectives of this course are

1. The main objective of this course to develop awareness and interest towards research.
2. The main objective of this course to development of scientific temperament.

Course Content:

The area of dissertation shall be assigned to the students at the end of semester based on the expertise available in the Department. The project oriented dissertation must be submitted by the end of eighth semester.Duringthecourseofcompletionofdissertationworkthestudentswill be required to complete various assignments given to them by their respective supervisors or the Head of Department for the purpose of their evaluation.
Besideclassroomseminars,thestudentswillhavetopresenttheirdissertationworkintheform of seminar before the board of examiners including the supervisors which will be followed by

viva voce examination.

Programme Name: B.Sc. Geology

Course code : GELOE003				
Course Name : Environment Geology				
Semester /Year : VIII				
	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. The main objective to understand the interaction of humans with the geological environment, familiarize students of challenges of environmental geology in the urban environment, and teach practical contribution that geologists can make in managing human interaction with the physical environment.

Course Content:

Unit I- Definition; History of Environmental Geology; Environmental Geology and Commercial reality; The tools of the Environmental geologist; Critical thinking about the environment.

[No. of Hours:10]

Unit II- GEOLOGICAL RESOURCES: Economic mineral resources; Construction resources; Water resources; Aesthetic and Scientific geological resources (aesthetic, cultural and scientific importance of Geology). **[No. of Hours:15]**

Unit III- NATURAL HAZARDS: Exogenic hazards; Endogenic hazards; Engineering geology in extreme events. **[No. of Hours:10]**

Unit IV:- WASTE AND POLLUTION MANAGEMENT: Waste management and geological environment; Waste and Pollution; Waste and Society; Wastes in open dumps; Landfilling wastes; Effluent treatment and disposal; Waste gases and the atmosphere; Radioactive wastes and management. **[No. of Hours:15]**

Unit V:- ENVIRONMENTAL GEOLOGY: AN URBAN CONCEPT: Urban Environments; Urban planning and geology. **[No. of Hours:10]**

Text Books:

TB1. Environmental Geology: Geology and the Human Environment by Bennett and Doyle by Wiley Publications

TB2. Environmental Geology by Jim Reichard by McGraw Hill

TB3. Environmental Science by Botkin and Keller by Wiley Publications

Reference Books:

RB1. Environmental Geology: Geology and the Human Environment by Bennett and Doyle by Wiley Publications

RB2. Environmental Geology by Jim Reichard by McGraw Hill

RB3. Environmental Science by Botkin and Keller by Wiley Publications

Course outcomes (COs):

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

CO1	To gain the knowledge and recognition of natural hazards and mitigation of their human impacts To understand and learn the concepts of environmental geology,
CO2	To understand and learn the managing geological resources,
CO3	To understand and learn the appropriate use of the geological environment for waste disposal
CO4	To classify the natural hazards and mitigation, their human impacts.
CO5	Write about the water and pollution waste managements.
CO6	Develop an urban concept: Urban Environments; Urban planning and geology