

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 Master of Geology

School of Basic & Applied Sciences

(w.e.f. 2023-24)

Patel Nagar, Dehradun, Uttarakhand

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Master of Geology

Programme outcome (POs)

PO 1	To provide an in-depth knowledge and skills in the field of Earth sciences to the students and research methods through laboratory, field and online modes of learning.
PO2	Recognize the need for sustainable use of earth resources, and value the environmental, indigenous and other community perspective on geological activities.
PO3	To understand and apply geological knowledge student will be capable appreciating the existence and exploration of natural resource system.
PO4	Apply the knowledge of geology makes the students fully competent to undertake any job in the field of Geology.
PO5	Work effectively and professionally along with multidisciplinary teams and be able to manage and analyse ethical issues.
PO6	To develop an interest for the student to take up higher studies in field of earth sciences.
PO7	Ability to recognize, evaluates, interpret, and understand issues and opportunities at the frontiers of geological domain.
PO8	To understand and communicate geological information concisely and accurately using written, visual, and verbal means appropriate to the situation.
PO9	Students will be fully aware of the earth environment and responsible for the management of environment
PO10	The students will be capable of appreciating the existence and exploration of natural resource system.
PO11	Makes the students fully competent to undertake any job in the field of Geology.
PO12	Gains complete knowledge about all fundamentals of Geoscience branches.

Program Specific Outcome (PSOs)

PSO1	To gain the knowledge of essential properties of earth components, including its core, mantle, asthenosphere, lithosphere, cryosphere, hydrosphere, atmosphere and biosphere.
PSO2	To understand the geomorphic process, structural & tectonics problems, petrological process, mineralogical and their properties & crystallographic orientation, chronological arrangement of rocks, economic mineral deposits, geophysical & mining methods, ore deposits and their occurrences, hydrogeological problems and environmental issues etc.
PSO3	Acquiring geologic data in the field, laboratory, satellites and big data from data banks, Analysing and interpreting the acquired data through application of scientific method.
PSO4	Apply knowledge and techniques from allied fields, including chemistry, physics, biology, mathematics, and computing, to solve geological problems.

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PSO5	Students take-up a geologic problem and utilize theoretical, analytical or experimental approach to solve the problem through their project work.
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Eligibility for admission:

B.Sc. /B.E with 45% and 40% in case of SC/ST categories with Geology as one of the subject

Duration of the Programme: 2 Year

STUDY & EVALUATION SCHEME
Choice Based Credit System
Master of 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	MGLC101	General Geology and Geomorphology	3			3	40	60	100
2	Core	MGLC102	Structural Geology	3			3	40	60	100
3	Core	MGLC103	Mineralogy	3			3	40	60	100
4	Core	MGLC104	General and Invertebrate Palaeontology	3			3	40	60	100
Practical										
1	Practical	MGLL105	Lab Course-I based on C101&C102				4	40	60	100
2	Practical	MGLL106	Lab course-II based on C103&C104				4	40	60	100
Total							20			

Second Semester

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S. No.	Course Category	Course Code	Course Name	Periods				Evaluation scheme		Subject Total
				L	T	P	C	Sessional (Internal)	External (ESE)	
Theory										
1	Core	MGLC201	Crystallography	3			3	40	60	100
2	Core	MGLC202	Geotectonics	3			3	40	60	100
3	Core	MGLC203	Micropaleontology, Vertebrate Palaeontology and Palaeobotany	3			3	40	60	100
4	Core	MGLC204	Stratigraphy	3			3	40	60	100
5	Core	MGLC205	Geological Field Training Tour				4	40	60	100
Practical										
1	Practical	MGLL206	Lab Course I based on C201 to C204				4	40	60	100
2										
Total							20	240	360	600

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	MGLC301	Igneous Petrology & Geochemistry	3			3	40	60	100
2	Core	MGLC302	Engineering Geology	3			3	40	60	100
3	Elective	MGLE304	Sedimentary and Metamorphic Petrology	3			3	40	60	100
4	Elective	MGLE305	Mineral exploration and Mining Geology	3			3	40	60	100
5	*Self-Study	MGLS307	Petroleum Geology	3			3	40	60	100
	*Self-Study	MGLS308	Environment Geology	3			3	40	60	100
Practical										
1	Practical	MGLL303	Lab Course based on C301&C302				4	40	60	100
2	Practical	MGLL306	Lab Course based on C304&C305				4	40	60	100
Total							20	240	360	600

*Excluding self-study credit.


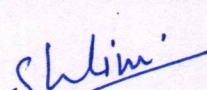
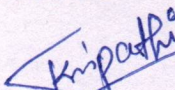
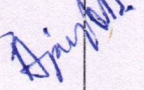
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Fourth Semester

S. No.	Course Category	Course Code	Course Name	Periods				Evaluation scheme		Subject Total
				L	T	P	C	Sessional (Internal)	External (ESE)	
Theory										
1	Core	MGLC401	Geohydrology	3			3	40	60	100
2	Core	MGLC402	Ore Genesis and Indian Mineral Deposits	3			3	40	60	100
3	Elective	MGLE404	Geological Field Training Tour				4	40	60	100
4	Elective	MGLE405	Project/Dissertation				6	40	160	200
Practical										
1	Practical	MGLL403	Lab course based on C401&C402				4	40	60	100
Total							20	240	360	600

Examination Scheme:

Components	I st Internal	II nd Internal	Presentation/ Assignment/ Project	External (ESE)
Weightage (%)	Marks	Marks	Marks	Marks
	20	20		60

M.Sc. Geology**1st Semester**

Course code	: MGLC101			
Course Name	: General Geology and Geomorphology			
Semester /Year	: 1st			
	L	T	P	C
	3			3

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

Course Objectives: The objectives of this course are

1. The course "Earth Surface Processes" is intended to provide a holistic approach to study the surficial features and the processes with emphasis on links and feedbacks between its components.
2. The subject will serve as a dynamic and physical based account of the processes at planet's surface with an integrated approach involving the principles of geomorphology
3. The course will provide opportunity to the students learn morphometric techniques in general and in the case of a drainage basin in particular

Course Content:

Unit 1:- Basic concepts and Application of geomorphology in Applied Geomorphology and Palaeo-geomorphology.

Unit 2:- Elementary idea of cosmogeny, Interior of earth, geochronology, theories of isostasy, ocean bottom topography cycle of erosion, rock weathering, soil formation and classification of soils.

Unit 3:- Geosynclines, their classification and evolution, orogeny and epeiorogeny, volcanoes, earthquakes, island arcs, rift valleys and grabens.

Unit 4:- Glacial, Aeolian, fluvial and costal landscapes of India, karst topography.

Unit 5:- Drainage development and slope morphometry, quaternary geomorphology, geomorphology and geomorphic hazards of Uttarakhand.

Text Books:

- TB1. Savindra singh , geomorphology, pravalika pub. Allahabad.
 TB2. Thornbury, W.D. (1980): Principle of Geomorphology, Wiley Eastern Ltd. New York.
 TB3. Sharma, H.S. (1990): Indian Geomorphology, Concept Publishing Co. New Delhi.
 TB4. Agrawal, L. C. Introduction to Geomorphology

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Reference Books:

- RB1. Holmes, A. (1992): Holmes Principles of Physical Geology, Chapman & Hall publ.
 RB2. Condie, Kent. C. (1982): Plate Tectonics & Crustal Evolution, Pergamon Press.

Course outcomes (COs):

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

CO1	To gain the knowledge about the solar system, Earth structure, geochronology, theories of isostasy
CO2	To understand about the geomorphic process and sedimentological processes related to fluvial, coastal, aeolian, and glacial regimes.
CO3	To apply the knowledge about the environmental changes and its impact on surface processes, landforms, weathering, soil and classification, ocean bottom topography cycle of erosion
CO4	To classify the stream orders and drainage system and concept and application of geomorphology
CO5	Differentiate between geosyncline and mountain building process their evolution, volcanoes, epeiorogeny etc.
CO6	Write about the slope morphometry, quaternary geomorphology, geomorphology and geomorphic hazards of Uttarakhand.

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	1	1	1	1	1	2	1	2	1	1	1	3	3	1	2	2
CO2	1	2	1	2	1	1	1	1	1	2	1	2	1	3	2	1	1
CO3	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3	2
CO4	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3	1
CO5	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3	2
CO6	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3	1

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

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M.Sc. Geology

Course code	: MGLC102			
Course Name	: Structural Geology			
Semester /Year	: 1st			
	L	T	P	C
	3			3

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 Content:

- Unit 1:-** Definition and scope of structural geology, properties of rocks and factors affecting the behavior of rocks.
- Unit 2:-** Theory of stress and strain, kinematic analysis, Mohr's Circles, strain and stress ellipsoids. Strain marker and Measurement of strain in deformed rocks.
- Unit 3:-** Geometry and Classification of fold & Mechanics of folding and buckling, Flexure fold; flexural slip folds, flexural flow folds, passive folds and distribution of strains in folds.
- Unit 4:-** Geometry and Causes and dynamics of faulting: Strike-slip Faults, Normal Faults, Thrust Faults; joints, foliations, unconformities.
- Unit 5:-** Basic idea about petrofabrics and use of Universal stage, diapers and salt domes, cleavage, lineation.

Text Books:

- TB1. Ghosh, S. K.: Structural Geology, Fundamental and Modern Concepts, Pergamon Press.
- TB2. Ramsay J. G. (1967): Folding and fracturing of Rocks, McGraw Hill Pub.
- TB3. Ramsay J.G. & Huber M. I. (1983): The Techniques of Modern Structural Geology- I, Strain Analysis, Academic Press.

Reference Books:

- RB1. Turner, F.J. & Weiss, L.E. (1963): Structural analysis of Metamorphic Tectonites, McGraw Hill publ.
- RB2. Jain, A.K, advance structural analysis, Nem chand and bros

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

CO1	To gain the knowledge and accurate geometric description of the structures observed in natural deformed rocks.
CO2	To understand the basic scope of structural geology, properties of rocks and factors affecting the behaviour of rocks.
CO3	To classify the fold, fault, joints and unconformities and other structures
CO4	To analyse kinematics of deformation, theory of stress, strain and stress ellipsoids
CO5	To estimate Strain marker and Measurement of strain in deformed rocks the stresses when rocks goes under the deformation by using Mohr's circle
CO6	Write about the Basic idea about petrofabrics and use of Universal stage, cleavage, lineation

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	1	1	1	1	1	2	1	2	1	1	1	3	3	1	2	2
CO2	1	2	1	2	1	1	1	1	1	2	1	2	1	3	2	1	1
CO3	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3	2
CO4	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3	1
CO5	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3	2
CO6	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3	1

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

M.Sc. Geology

Course code	: MGLC103			
Course Name	: Mineralogy			
Semester /Year	: 1 st			
	L	T	P	C
	3			3

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.

Course Content:

Unit 1:- structures and types of atoms, types of chemical bonding, chemical properties of minerals.

Unit 2:- Structures and classification of Silicates, Physical properties of minerals.

Unit 3:- A detail study of important silicates with reference to general and structure formulae, classification, atomic structures, chemistry including substitution of element and mode of occurrence.

a) Neosilicates/orthosilicates: olivine group and Garnet group.

b) Sorosilicate: melilite group

c) Cyclosilicate: beryl

d) Inosilicate: pyroxene and amphibole group.

e) Phyllosilicate: kaolinite group.

f) Tectosilicate: feldspar group.

Unit 4:- Properties of uniaxial and biaxial minerals.

Text Books:

TB1. Moor house, W.W.: Optical Mineralogy.

TB2. Dana, E.S. & Ford, W.E.: A Text book of Mineralogy, Wiley Eastern Ltd.

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

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TB4. Barry & Mason- Mineralogy.

Reference Books:

- RB1. Dexter perkin, optical mineralogy
 RB2. Alexander N. winchill ,element of optical mineralogy, ulan press pub.
 RB3. Babu .S.K and sinha.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 chemical bonding, types of atom, and properties of minerals, different silicate structure, uniaxial and biaxial crystal.
CO2	Understand Properties of uniaxial and biaxial crystal
CO3	Explain structure of silicates.
CO4	Classify Silicate, and Explain the different properties of minerals.
CO5	Distinguish among different properties of minerals.
CO6	Compose structure of various silicates.

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	1	1	1	1	1	2	1	2	1	1	1	3	3	1	2	2
CO2	1	2	1	2	1	1	1	1	1	2	1	2	1	3	2	1	1
CO3	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3	2
CO4	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3	1
CO5	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3	2
CO6	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3	1

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

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M.Sc. Geology

Course code	: MGLC104			
Course Name	: General and Invertebrate Palaeontology			
Semester /Year	: 1 st			
	L	T	P	C
	3			3

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

Course Objectives: The objectives of this course are

1. Making students understand the evolution of life in geological past is an important aspect of geology. Palaeontology, the study of fossils includes the study of vertebrate and invertebrate fossils, micro-fossils, plant fossils, trace fossils their evolution and distribution in time and space. These aspects are fundamental not only to geology and stratigraphy but inter-disciplinary fields of botany, zoology and branches of science.
2. The study of Palaeontology encompasses the aspects of appearance, evolution and extinction of life through the geologic time. The knowledge of palaeontology would enable the students to understand the biological changes that occurred in the history of the earth and relate them with their field observations.
3. The students will acquire skills of describing fossils and their taxonomic classification. They will also be introduced to the application of palaeontology and the use of fossils in hydrocarbon exploration, establishing biostratigraphy, inferring paleoecology, paleobiogeography of the geological past.

Course Content:

Unit 1:-Modern Taxonomy, Identification of fossil, types of fossils, and mode of preservation, uses of fossils.

Unit 2:-Biostratigraphy, Paleocology, and origin of life.

Unit 3:-Early Precambrian life, Ediacaran fossil assemblage and organo-sedimentary structures.

Unit 4:-Classification, Morphology, Evolutionary trend and geological history of major invertebrate group: Mollusca (Bivalve, Gastropoda and Cephalopoda), Brachipoda, Arthropoda,

Unit 5:-Zoogeographic provenance, dispersal and extinction.

Text Books:

TB1. Jain, P.C.&Anantharaman, M.S., 1983.Paleontology: Evolution& Animal Distribution. Vishal

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TB2. Clarkson, E. N.K. (1998): Invertebrate Paleontology and Evolution.

TB3. Smith, A.B. (1994): Systematic and fossil record- Documenting Evolutionary patterns.

Reference Books:

RB1. Henry woods, invertebrate paleontology,

RB2. Shrock and twen hofel, principle of invertebrate paleontology

Course outcomes (COs):

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

CO1	Gain the basic knowledge of fossils, Identification of fossils, origin and evolution of life, dispersion and extinction.
CO2	Classify types of fossils, morphology and geological distribution of various groups.
CO3	Techniques of collection of fossils, explain the mode of preservation, Explain the origin of life.
CO4	Compare the evolutionary relationships among a set of organisms, types of fossils.
CO5	Summarize the modes of life of fossil organisms, Biostratigraphy, Paleocology and Uses.
CO6	To develop the fundamentals concept of Zoogeographic provenance, dispersal and extinction of organism, Early Precambrian life, organo-sedimentary structures

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	1	1	1	1	1	2	1	2	1	1	1	3	3	1	2	2
CO2	1	2	1	2	1	1	1	1	1	2	1	2	1	3	2	1	1
CO3	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3	2
CO4	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3	1
CO5	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3	2
CO6	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3	1

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M.Sc. Geology

Course code	: MGLL105			
Course Name	: Lab Course based on C101&C102			
Semester /Year	: 1 st			
	L	T	P	C
				4

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

Course Objectives: The objectives of this course are

1. The main objective of this course is to understand geomorphological features from various morphogenetic regions of India.
2. To understand the morphometry of drainage basins, analysis of orientation structures.
3. To understand the structural problems, Preparation and interpretation of geological maps and sections.

Course Content:

Unit1-General Geology and Geomorphology

- Analysis of geomorphological features from various morphogenetic regions of India; preparation of geomorphological maps on different scales (1:25,000, 50,000 & 1:50,000).
- Preparation of longitudinal and cross valley profiles.
- Altimetric analysis, hypsometric analysis, exercises related to measurements of run off dynamics, sediment and solute dynamics.
- Morphometry of drainage basins, analysis of orientation structures.

Unit2-Structural Geology

- Preparation and interpretation of geological maps and sections.
- Structural problems.

Text Books:

TB1. Guhey Rajeev, Geology: Principles and Practical Manual, New India Publishing Agency-Nipa

TB2. Practical Approach to Crystallography and Mineralogy 2Nd Edition 2017 by Hota, CBS

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Reference Books:

RB1. Guhey Rajeev, Geology: Principles and Practical Manual, New India Publishing Agency-
Nipa

RB2. Practical Approach to Crystallography and Mineralogy 2Nd Edition 2017 by Hota, CBS
Publishers and Distributors

Course outcomes (COs):

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

CO1	To gain the knowledge of different drainage patterns and stream numbers orders
CO2	To understand and preparation and interpretation of geological maps and sections.
CO3	Structural problems and Altimetric analysis, hypsometric analysis, exercises related to measurements of runoff dynamics, sediment and solute dynamics. Morphometry of drainage basins, analysis of orientation structures.
CO4	To analysis of geomorphological features from various morphogenetic regions of India
CO5	Estimate and measurements of runoff dynamics, sediment and solute dynamics.
CO6	Preparation of longitudinal and cross valley profiles and preparation of geomorphological maps on different scales (1:25,000, 50,000 & 1:50,000).

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	1	1	1	1	1	2	1	2	1	1	1	3	3	1	2	2
CO2	1	2	1	2	1	1	1	1	1	2	1	2	1	3	2	1	1
CO3	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3	2
CO4	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3	1
CO5	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3	2
CO6	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3	1

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M.Sc. Geology

Course code	: MGLL106			
Course Name	: Lab Course based on C103&C104			
Semester /Year	: 1 st			
	L	T	P	C
				4

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

Course Objectives: The objectives of this course are

1. This course provides the knowledge and identifies common rock-forming minerals in hand specimen and in thin section using diagnostic physical, optical, and chemical properties.
2. This course provides the knowledge of invertebrate fossils record and students will be able to interpret the modes of life of fossil organisms

Course Content:**Unit1-Mineralogy**

- Study of minerals in hand specimen
- Microscopic study of rock forming minerals.

Unit2-General& Invertebrate Paleontology

- Study of important invertebrate fossil belonging to brachiopoda, bivalve, gastropoda, cephalopoda, and trilobite.

Text Books:

TB1. Guhey Rajeev, Geology: Principles and Practical Manual, New India Publishing Agency-Nipa

TB2. The Practical Geologist: The Introductory Guide to the Basics of Geology and to Collecting and Identifying Rocks Dixon, Dougal, Publisher Touchstone

Reference Books:

RB1. Guhey Rajeev, Geology: Principles and Practical Manual, New India Publishing Agency-Nipa

RB2. The Practical Geologist: The Introductory Guide to the Basics of Geology and to Collecting and Identifying Rocks Dixon, Dougal, Publisher Touchstone

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

CO1	To gain the knowledge and study of minerals in hand specimen Microscopic study of rock forming minerals.
CO2	To understand the mineral properties, nature and evolution under the microscope
CO3	To classify the important invertebrate fossil belonging to brachiopoda, bivalve, gastropoda, cephalopoda, trilobite.
CO4	To analyses the morphological characteristics of invertebrate fossils
CO5	To evolution mineral properties, mineral nature and characteristic under the microscope
CO6	Draw the silicate structures

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	1	1	1	1	1	2	1	2	1	1	1	3	3	1	2	2
CO2	1	2	1	2	1	1	1	1	1	2	1	2	1	3	2	1	1
CO3	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3	2
CO4	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3	1
CO5	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3	2
CO6	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3	1

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

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M.Sc. Geology
2nd Semester

Course code	: MGLC201			
Course Name	: Crystallography			
Semester /Year	: 2 nd			
	L	T	P	C
	3			3

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

Course Objectives: The objectives of this course are

1. The objective of this course is to present the basic concepts needed to understand the crystal structure of materials. Fundamental concepts including lattices, symmetries, point groups, and space groups will be discussed and the relationship between crystal symmetries and physical properties will be addressed.
2. The theory of X-ray diffraction by crystalline matter along with the experimental x-ray methods used to determine the crystal structure of materials will be covered.
3. Application of X-ray diffraction to proteins, electron diffraction and neutron diffraction will be briefly discussed.

Course Content:

Unit 1:-Introduction to space group, space lattices, lattice defects, symmetry elements.

Unit 2:-Historical development of X-ray crystallography, Bragg equation, goniometer.

Unit 3:-Description of normal classes and important sub-classes.

Unit 4:-Different type of crystal projection and crystal imperfections.

Unit 5:-Twinning and twinning laws – common types of twins and their examples.

Text Books:

- TB1. Dana, mineralogy
TB2. Perkinson. D, mineralogy

Reference Books:

- RB1. Wahlstrom-optical crystallography.
RB2. Sands, D.E. (1975): An Introduction. to Crystallography, W.A. Benjamin Inc., N.Y.
RB3. Phillips, F.C.: Introduction to Crystallography.
RB4. Evans, R.C. (1964): Introduction to Crystal Chemistry, Cambridge Uni. Press.

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

CO1	Gain knowledge of space group, space lattice, defects, symmetry elements, Bragg's Law, goniometer, normal class of crystal system, projection, imperfection, twinning
CO2	Explain the concepts of normal class of crystal system, lattice defects, point, and imperfection.
CO3	Apply the basic concept of twinning and its application and methods of X-ray on the crystal system.
CO4	Evaluate Bragg's law and explain different type of crystal projection.
CO5	To estimate the packing density of Braves lattice and describe different diffraction methods and symmetry elements of normal class.
CO6	Express the views on goniometer, symmetrical elements of different crystal system and imperfection of crystal.

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	1	1	1	1	1	2	1	2	1	1	1	3	3	1	2	2
CO2	1	2	1	2	1	1	1	1	1	2	1	2	1	3	2	1	1
CO3	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3	2
CO4	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3	1
CO5	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3	2
CO6	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3	1

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

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M.Sc. Geology

Course code	: MGLC202			
Course Name	: Geotectonics			
Semester /Year	: 2 nd			
	L	T	P	C
	3			3

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, palaeomagnetism, 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:

Unit 1:-Evidence of continental drift, mechanics, objections and present status, Concept of Plate Tectonics.

Unit 2:- Major tectonic features of the oceanic and continental crust, island arcs, oceanic islands and volcanic arcs, Gravity and magnetic anomalies at mid oceanic ridges, Origin and significance of Mid-Oceanic Ridges and Trenches.

Unit 3:- Seismic belts of the earth & seismicity and mountain chains, their global distribution and evolution.

Unit 4:- Sea floor spreading, Palaeo-magnetism, Polar Wandering and reversal of earth's magnetic field.

Unit 5:- Origin of Himalaya, Tectonic history of India & geodynamics of Indian plate.

Text Books:

TB1. Condie Kent, C. (1989): Plate Tectonics and Crustal Evolution.

TB2. W. J. Kious & Robert I.T.: This dynamic of Earth: the story of Plate Tectonics USGS publ.

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

Reference Books:

RB1. Keary, P. & Vine, F.J. 1990: Global Tectonics. Blackwell scientific publ.

RB2. Storetvedt, K.N. 1997: Our Evolving Planet. Earth History in new perspective.

RB3. Valdiya, K.S. 1998: Dynamics Himalaya. 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 and geodynamics of Indian plate
CO6	Write about the Palaeo magnetism and paleo magnetic maps , polar wandering curve and sea floor spreading and evolution of Himalayas

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	1	1	1	1	1	2	1	2	1	1	1	3	3	1	2	2
CO2	1	2	1	2	1	1	1	1	1	2	1	2	1	3	2	1	1
CO3	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3	2
CO4	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3	1
CO5	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3	2
CO6	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3	1

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

Kripa *Shilpi* *Ajay*

M.Sc. Geology

Course code	: MGLC203			
Course Name	: Micropaleontology, Vertebrate Palaeontology and Palaeobotany			
Semester /Year	: 2 nd			
	L	T	P	C
	3			3

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

Course Objectives: The objectives of this course are

1. This course covers basically the evolution of vertebrates from basal fishes to hominids.
2. The main objective of the course is to impart knowledge on diversity, evolution, and interrelationships among vertebrates.
3. It is also aimed at providing insights into current debates on vertebrate paleobiology and geological and biological processes responsible for vertebrate evolution.

Course Content:

Unit 1:- Microfossils; types of microfossils and its Importance, Collection and preparation of microfossils.

Unit 2:- Micro-paleontology: morphology, Palaeo-ecology and geological distribution of foraminifera, conodonts, ostracodes, radiolaria and diatoms.

Unit 3:- Vertebrate life through ages and landmarks in their evolution, evolutionary trends in man, horse and elephant.

Unit 4:- Palaeobotany: Morphology, distribution and significance of Gondwana flora.

Unit 5:- Palynology: Morphology and significance of pollen and spores.

Text Books:

- TB1. Romer, A.S. 1966. Vertebrate Paleontology, Chicago Univ. Press.
 TB2. Swinnerton, H.H. (1950) An outline of palaeontology.
 TB3. Arnold, C.A. (1947) An Introduction to palaeobotany, Mc Graw Hill.

Reference Books:

- RB1. Armstrong, H. & Brasier M. (2005): Micro fossils. Black Well pub.
 RB2. Colbert, E.H.(1984) Evolution of the vertebrates. Willey Eastern Ltd.

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

CO1	Gain knowledge of the main systematic groups of vertebrate, microfossils, its distribution and Paleobotany and Palynology.
CO2	Distinguish various microfossils group on the basis of morphology, pollen and spores.
CO3	Collection and preparation of microfossils, and Explain the morphology of Gondwana flora.
CO4	To analyse descriptive data of microfossils and associated sedimentary materials using adequate concepts, methodologies.
CO5	Correlated the concept of pollen and spores, and morphology of various group.
CO6	To construct the phylogeny of man, horse and elephant and pollen and spores..

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	1	1	1	1	1	2	1	2	1	1	1	3	3	1	2	2
CO2	1	2	1	2	1	1	1	1	1	2	1	2	1	3	2	1	1
CO3	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3	2
CO4	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3	1
CO5	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3	2
CO6	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3	1

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

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M.Sc. Geology

Course code	: MGLC204			
Course Name	: Stratigraphy			
Semester /Year	: 2 nd			
	L	T	P	C
	3			3

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

Course Objectives: The objectives of this course are

1. The course is intended to familiarize the student with stratigraphic principles and nomenclature, major stratigraphic units, methods of stratigraphic correlation, depositional environments and tectonostratigraphic framework of various lithostratigraphic units of India spanning Archaean to Holocene, and mass extinction boundaries.

Course Content:

Unit 1:-Principle of Stratigraphy and its type, Geological time scale, stratigraphic correlation, nomenclature of modern stratigraphic code, Walther's Law

Unit 2:- Archean and Precambrian stratigraphy of peninsular India.

Unit 3:- Phanerozoic stratigraphy of Peninsular India.

Unit 4:- Precambrian and Phanerozoic stratigraphy of Himalaya and Indo-Gangetic Plain.

Unit 5:- Precambrian-Cambrian, Permian-Triassic, Cretaceous- Tertiary boundaries (with Indian examples)

Text Books:

TB1. Naqvi, S.M. & Rogers, J.J.W. (1987): Precambrian Geology of India, Oxford Univ. Press.

TB2. Schoch, Robert, M. (1989): Stratigraphy-Principles and Methods, Van Nostrand

Reinhold, New York. .

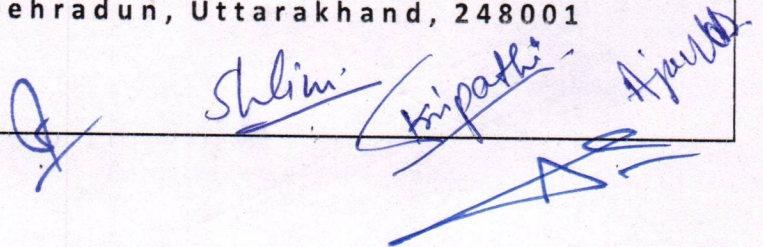
TB3. Kumar, R. (1984): Fundamentals of Historical Geology & Stratigraphy of India.

TB4. Krishnan, M.S. (1982): Geology of India and Burma, C.B.S. Publishers & Distributors, Delhi.

TB5. Valdiya, K.S. (2009): The Making Of India: Geodynamic Evolution. Macmillan

Publishers India

TB6. Ramakrishnan M. and Vaidyanadhan,(2008 &2010) Geology of India (Vol. 1 & 2), GSI pub.



Reference Books:

- RB1. Dunbar, C.O. & Rodgers, J. (1957): Principles of Stratigraphy, John Wiley & Sons.
 RB2. Krumbein, W. C. & Sloss, L.L. (1963): Stratigraphy and sedimentation.
 RB3. Freeman, W. H. & Kummel, Co. (1961): History of the earth.
 RB4. Hollis D. Hedberg (Ed.) International stratigraphic guide - International sub
 commission on
 RB5. Stratigraphic classification of IUGS commission on stratigraphy John Wiley and
 Sons

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 stratigraphic boundaries eg: PC, PT, KT with Indian example
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	PSO5
CO1	2	1	1	1	1	1	2	1	2	1	1	1	3	3	1	2	2
CO2	1	2	1	2	1	1	1	1	1	2	1	2	1	3	2	1	1
CO3	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3	2
CO4	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3	1
CO5	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3	2
CO6	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3	1

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

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M.Sc. Geology

Course code	: MGLC205			
Course Name	: Geological Field Training Tour			
Semester /Year	: 2 nd			
	L	T	P	C
				4

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

Course Objectives: The objectives of this course are

1. Geological field work is important to understand rocks in their natural environment and their natural relationship to one another.
2. It seeks to describe and explain the surface feature and underground structure of the lithosphere based upon observations and inferences.

Course Content:

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

Geological field mapping and 3 days tour

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 to

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

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CO4	To analyse 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.

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	1	1	1	1	1	2	1	2	1	1	1	3	3	1	2	2
CO2	1	2	1	2	1	1	1	1	1	2	1	2	1	3	2	1	1
CO3	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3	2
CO4	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3	1
CO5	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3	2
CO6	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3	1

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

M.Sc. Geology

Course code	: MGLL206			
Course Name	: Lab Course based on C201 to C204			
Semester /Year	: 2 nd			
	L	T	P	C
				4

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

Course Objectives: The objectives of this course are

1. This course will provides the basic knowledge of crystal and learn how the orientation of, axis of symmetry, plane of symmetry and centre of symmetry by using the crystal model.
2. This course will provide the basic understanding of stereographic projection by using the filed data.
3. Study morphology and age of the vertebrate fossils with hand specimen and micro-organism by using the microscope. Study about the chronology of the rocks.

Course Content:**Unit1- Crystallography**

- Crystal model and projection

Unit2- Geotectonics

- Stereographic presentation of structural data

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Unit3- Micropaleontology, vertebrate paleontology and Palaeobotany

- Study of important Microfossils,
- Study of Vertebrate fossils and Gondwana Flora

Unit4- Stratigraphy

- Study of paleo-geographic maps of Precambrian and Phanerozoic
- Chronological study of important rocks

Text Books:

TB1. Guhey Rajeev, Geology: Principles and Practical Manual, New India Publishing Agency-Nipa

TB2. Practical Approach to Crystallography and Mineralogy 2Nd Edition 2017 by Hota, CBS Publishers and Distributors

Reference Books:

RB1. Guhey Rajeev, Geology: Principles and Practical Manual, New India Publishing Agency-Nipa

RB2. Practical Approach to Crystallography and Mineralogy 2Nd Edition 2017 by Hota, CBS Publishers and Distributors

Course outcomes (COs):

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

CO1	To gain the knowledge of Crystal model and projection
CO2	To understand and study of important Microfossils, Study of Vertebrate fossils and Gondwana Flora
CO3	To classify paleo-geographic maps of Precambrian and Phanerozoic
CO4	Chronological study of important rocks
CO5	the Stereographic presentation of structural data,
CO6	To develop the Crystal model and projection

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	1	1	1	1	1	2	1	2	1	1	1	3	3	1	2	2
CO2	1	2	1	2	1	1	1	1	1	2	1	2	1	3	2	1	1
CO3	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3	2
CO4	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3	1
CO5	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3	2
CO6	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3	1

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

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M.Sc. Geology

3rd Semester

Course code	: MGLC301			
Course Name	: Igneous Petrology and Geochemistry			
Semester /Year	: 3 rd			
	L	T	P	C
	3			3

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 behaviour 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:-Magmatic processes: fractional crystallization, magma mixing, crystal setting, liquid immiscibility, assimilation, differentiation, and effects, magmatic crystallization - Bowens reaction principle.

Unit 2:-Gibbs phase rule - definition of phase, component and degree of freedom, application of Phase rule in bi-component and tri component magma. The Phase equilibrium of binary (Ab-An, Ab-Or, Di-An), ternary magma (An-Al-Di system and An- Di - Fo, system).

Unit 3:-Texture and structures, IUGS classification of the volcanic and plutonic Igneous rocks, and ophiolite

Unit 4:-Petrogenesis and petrography of the following rocks:- Aplite, Anorthosite, Andesite, Basalt, Carbonatite, Charnockite, Diorite, Dunite, Dolerite, Gabbro, Granite, Granodiorite, Kimberlite, Komatiite, Lamprophyre, Pegmatite, Peridotite, Syenite, Trachyte.

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Unit 5:-Introduction of Geochemistry, Chemical composition and properties of Earth's layers. Atmosphere: its layers, chemical composition and chemistry of Atmosphere and hydrosphere, geochemical classification of elements, meteorite and their classification.

Text Books:

- TB1. Gupta, A.K. (1998): Igneous Rocks Allied Publishers Ltd., New Delhi
 TB2. Jackson: Textbook of lithology.
 TB3. Winter, J.D. (2001): An Introduction to Igneous and Metamorphic Petrology
 TB4. McBirney, A.R. (1984): Igneous Petrology, Freeman Cooper & Co. California.
 TB5. Phillips A.: Introduction to igneous and metamorphic petrology, Prentice Hall Pub.

Reference Books:

- RB1. Turner, F.J. & Verhoogen, J.: Igneous & Metamorphic petrology CBS Publications.
 RB2. Bose, M.K. (1997): Igneous Petrology, World Press, Kolkatta.
 RB3. Best, Myron G. (2002): Igneous and Metamorphic Petrology, Blackwell Science.
 RB4. Mason, geochemistry
 RB5. Krauskopf, geochemistry

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 and application of Gibbs phase rule in Uni component, Bi component and Tri component system
CO6	Write the process of magmatism, petrography of igneous rock and geochemistry of Earth's

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	1	1	1	1	1	2	1	2	1	1	1	3	3	1	2	2
CO2	1	2	1	2	1	1	1	1	1	2	1	2	1	3	2	1	1
CO3	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3	2
CO4	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3	1
CO5	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3	2
CO6	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3	1

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

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M.Sc. Geology

Course code	: MGLC302			
Course Name	: Engineering Geology			
Semester /Year	: 3 rd			
	L	T	P	C
	3			3

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

Course Objectives: The objectives of this course are

1. In order to construct a safe, long lasting and profitable benefit cost ratio structure the application of geological knowledge is very much in demand.
2. The subject owes its growth to many civil structures which failed due to lack of geological application in the past. Therefore, study of engineering geology is required.

Course Content:

Unit 1:-Role of Engineering geology in civil construction and mining industry; Engineering properties of rocks ;physical characters of building stones, concrete and other aggregates.

Unit 2:-Geological considering for evaluation of dam and reservoir site.

Unit 3:-Geotechnical investigation of tunnels - type, methods and problems and road.

Unit 4:-Landslides - classification, causes and preventive methods.

Unit 5:-Bridges - types and foundation problems influence of geological conditions on foundation and design of buildings.

Text Books:

TB1. Krynine D. P. & Judd W. R. (1998): Principles of engineering geology & geo-techniques.

TB2. Gupta, H. K. & Rastogi, B. K. (1976): Dams and Earthquakes, Elsevier and Scientific Pub. Co.

TB3. Clarke: Reservoir engineering.

Reference Books:

RB1. Bell, F. G. (1983): Fundamentals of engineering geology, Butterworth's, London.

RB2. Schuttz, J.R and Cleaves, A.B.(1951) Geology in Engineering, John Willey and Sons, New York.

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Course outcomes (COs):

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

CO1	To gain the knowledge about the selection of most suitable sites for any civil structure, over or underground.
CO2	To understand the selection of suitable construction materials for any such project work (e.g.-Dam, Tunnel etc.)
CO3	To construct and ensuring that the structure will last long and serve the purpose for which it has been built.
CO4	To analyses lithology and structures of the area to leading the way for infrastructural development for the country.
CO5	To evaluate the geologic hazards and others adverse conditions like seismic hazards and landslide etc.
CO6	To develop and create the detailed design of engineering works. Engineering geologists also provide geologic data on topographic maps, aerial photographs, geologic maps, <u>Geographic Information System (GIS)</u> maps, or other map bases

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	1	1	1	1	1	2	1	2	1	1	1	3	3	1	2	2
CO2	1	2	1	2	1	1	1	1	1	2	1	2	1	3	2	1	1
CO3	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3	2
CO4	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3	1
CO5	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3	2
CO6	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3	1

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

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M.Sc. Geology

Course code	: MGLE304			
Course Name	: Sedimentary and Metamorphic Petrology			
Semester /Year	: 3 rd			
	L	T	P	C
	3			3

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

Course Objectives: The objectives of this course are

1. The purpose of this course is to give you a broad understanding of how sedimentary rocks form and how they evolve as they undergo burial. This starts with understanding sediment composition and how this can be used to infer source area characteristics.
2. We will study how, beginning soon after deposition, sediments become lithified. This includes both chemical and physical transformations that lead to major changes in the original petro physical (porosity and permeability) characteristics of sediments and sedimentary rocks as lithification and diagenesis occur
3. 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 petrogenetic processes involving mineral reactions will be explored using equilibrium thermodynamics.

Course Content:

- Unit 1:-**Origin of Terrigenous Clastic and Non-Clastic grains; weathering and its products, structure, texture of sedimentary rocks.
- Unit 2.** Sedimentary facies, depositional environments, provenance and Palaeo-current.
- Unit 3:-** Factors are controlling metamorphism; Texture and structures of metamorphic rocks.
- Unit 4:-**Metamorphic grades and Index minerals; types of metamorphism, law of thermodynamics and Gibbs Equation.
- Unit 5:-**Metamorphic Facies: Zeolite, Blue-schist, Green-schist - Amphibolite, Granulite, Eclogite and contact metamorphic facies.

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Text Books:

- TB1. Pettijohn, F. J. Sedimentary rocks (McGraw-Hill, New Delhi)
 TB2. Blatt, H., Middleton, G and Murray, R., Origin of Sedimentary Rocks, Prentice Hall
 TB3. Verma, V. K. And Prasad, C., Sedimentology (Harman Publishing House, New Delhi)
 TB4 Collins,J.D., and Thompson,D.B.(1982):Sedimentary structures.George Allen and

Unwin,London.

TB5 Pettijohn,F.J.(1975): Sedimentary Rocks.3rd Edn.Harperand Row Publ, New Delhi

Reference Books:

- RB1. Tucker,M.E.(1981): Sedimentary Petrology: An Introduction,Wiley & Sons,
 RB2. Winter, J.D. (2001): An Introduction to Igneous and Metamorphic Petrology New York.
 RB3. Bucher,k. and Martin,F.2002: Petrogenesis of Metamorphic Rocks, Springer-Verlag,
 7th Revised Edition.
 RB4. Yardley, B.W.D:1989: An Introduction to Metamorphic petrology, Longman
 scientific &Technical, New York.
 RB5. Spry, A.1976: Metamorphic Texture, Pergamon Press.

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 Sedimentary and Metamorphic rock.
CO3	Explain the use of Petrography of Sedimentary and Metamorphic rock on the bases of texture and structure.
CO4	Classify the sedimentary and Metamorphic rocks
CO5	Distinguish between different types of sedimentary and metamorphic rocks.
CO6	Write the process of sedimentation and 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	PSO5
CO1	2	1	1	1	1	1	2	1	2	1	1	1	3	3	1	2	2
CO2	1	2	1	2	1	1	1	1	1	2	1	2	1	3	2	1	1
CO3	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3	2
CO4	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3	1
CO5	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3	2
CO6	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3	1

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

Kripalika *A* *Shalin* *Ajay*

M.Sc. Geology

Course code	: MGLE305			
Course Name	: Mineral Exploration and Mining Geology			
Semester /Year	: 3 rd			
	L	T	P	C
	3			3

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

Course Objectives: The objectives of this course are

1. 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:

Unit 1:-Prospecting for economic minerals, sampling assaying and evaluation of mineral deposits, geological and geo-botanical techniques of prospecting.

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 electrode configuration, field procedure: profiling and sounding and magnetic, seismic and radioactive methods.

Unit 3:-Brief outline of well-logging techniques and their methods, Drilling and type of drilling methods, Application of remote sensing in mineral exploration.

Unit 4:-Planning, exploration and exploratory mining of surface and underground mineral deposits involve shaft sinking, drifting, cross cutting, winzing, stoping, room and pillaring, top- slicing, sub caves and block caving.

Unit 5:-Cycles of surface and underground mining operations, coal mining and mining hazards: mine inundation, fire and rock burst.

Text Books:

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

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

Shripad *Shilini* *Ajith*

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

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	1	1	1	1	1	2	1	2	1	1	1	3	3	1	2	2
CO2	1	2	1	2	1	1	1	1	1	2	1	2	1	3	2	1	1
CO3	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3	2
CO4	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3	1
CO5	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3	2
CO6	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3	1

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

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M.Sc. Geology

Course code	: MGLL303			
Course Name	: Lab Course based on C301&C302			
Semester /Year	: 3 rd			
	L	T	P	C
				4

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

Course Objectives: The objectives of this course are

1. 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.
2. The aim of this course is to understand how Interpret the geological maps for landslides, Tunnel, Dam etc., problems.
3. The aim of this course is to understand survey of plot using chain, prismatic compass and plane table survey.

Course Content:**Unit1-Igneous Petrology & Geo Chemistry**

- Megascopic study of different types of igneous rocks.
- Microscopic study of important igneous rocks.
- Plotting of modal data is IUGS diagram.

Unit2- Engineering Geology

- Study of properties of common rocks with reference to their utility in engineering projects. Study of maps and models of important engineering structures, dam sites and tunnels. Interpretation of geological maps for landslides problems.
- Survey of a plot using Chain, Prismatic compass, Plane table, GPS data collection and plotting.

Text Books:

- TB1. W.S. Mackenzie, C. Guilford, Atlas of the Rock-Forming Minerals in Thin Section
 TB1. Engineering Geology Practicals 2Nd Edition 2018 by MT Maruthesha Reddy, New Age International (P) Ltd Publishers

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

Press

Reference Books:

RB1. Engineering Geology Practicals 2Nd Edition 2018 by M T Maruthesha Reddy, New Age International (P) Ltd Publishers

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

Course outcomes (COs):

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

CO1	To gain the knowledge of Megascopic study of different types of igneous rocks. Microscopic study of important igneous rocks.
CO2	To understand the properties of common rocks with reference to their utility in engineering projects.
CO3	To classify and study of maps and models of important engineering structures, dam sites and tunnels.
CO4	To analyse the survey of a plot using Chain, Prismatic compass, Plane table, GPS data collection and plotting.
CO5	Interpretation of geological maps for landslides problems.
CO6	Plotting of modal data is IUGS diagram

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	1	1	1	1	1	2	1	2	1	1	1	3	3	1	2	2
CO2	1	2	1	2	1	1	1	1	1	2	1	2	1	3	2	1	1
CO3	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3	2
CO4	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3	1
CO5	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3	2
CO6	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3	1

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

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M.Sc. Geology

Course code	: MGLL306			
Course Name	: Lab Course based on E304&E305			
Semester /Year	: 3 rd			
	L	T	P	C
				4

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

Course Objectives: The objectives of this course are

1. The aim of this course is to understand how sedimentary and metamorphic rocks are classified based on the mineralogy and textures and how these can be used to interpret their history. Upon completion of this course, the student will be able to identify sedimentary and metamorphic rocks and explain the processes by which the rocks formed based on the textural associations of the mineral assemblages.
2. Graphic construction of ACF, AKF and AFM diagrams.
3. Upon completion of this course, the student will be able to preparation of mineral maps of India, calculation of grade and ore reserves etc.

Course Content:

Unit1- Sedimentary & Metamorphic Petrology

- Study of sedimentary and metamorphic rocks in thin sections with emphasis on texture, structure and mineral composition.
- Study of sedimentary and metamorphic rocks in hand specimen.
- Graphic construction of ACF, AKF and AFM diagrams.

Unit2- Mineral Exploration and Mining Geology

- Preparation of mineral maps of India.
- Graphical representation of production, export and import of important minerals.
- Calculation of grade and ore reserves.
- Interpretation of remote sensing data for mineral exploration.

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

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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 gain the knowledge and preparation of mineral maps of India. Graphical representation of production, export and import of important minerals.
CO2	To classify and understand the nature of sedimentary and metamorphic rocks in hand specimen.
CO3	To analyse the sedimentary and metamorphic rocks in thin sections with emphasis on texture, structure and mineral composition.
CO4	To analyses and interpretation of remote sensing data for mineral exploration.
CO5	To estimate the average grade and ore reserves.
CO6	To develop and graphic construction of ACF, AKF and AFM diagrams.

CO-PO-PSO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	1	1	1	1	1	2	1	2	1	1	1	3	3	1	2	2
CO2	1	2	1	2	1	1	1	1	1	2	1	2	1	3	2	1	1
CO3	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3	2
CO4	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3	1
CO5	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3	2
CO6	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3	1

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

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M.Sc. Geology

Course code	: MGLS307			
Course Name	: Petroleum Geology			
Semester /Year	: 3 rd			
	L	T	P	C
	3			3

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

Course Objectives: The objectives of this course are

1. The main basic objective of this course is to understand the, how a geologist find out the hydrocarbon reserves by using the basic fundamentals of geology that needs to be understood and integrated with engineering data to effectively and optimally manage petroleum reservoirs.

Course Content:

Unit 1:-Physical and chemical properties of natural gas, oil and bitumen, their mode of occurrence, kerogen-shales, origin of petroleum, coal bed methane and gashydrate.

Unit 2:-Reservoir rocks, their classification, important characters, structures and mechanics, migration of oil and gas, Gussove's theory of oil and gas pools.

Unit 3:-Oil traps, their classification and characters, Surface indication of oil, geological, geophysical and geochemical prospecting for hydrocarbons.

Unit 4:-Drilling and well logging for oil, well completion, and secondary recovery.

Unit 5:-Geographical distribution of petroleum resources in world, Status of hydrocarbon exploration in India, important petroliferous basins of India.

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Text Books:

- TB1. Geology Of Petroleum 2Ed (Pb 2004) by LEVORSEN A.I.
 TB2. Emmons William Harvey, Geology of Petroleum

Reference Books:

- RB1. The World Of Petroleum by B.G. Deshpande, New Age International (P) Ltd.,

Publishers

- RB2. Nath Mahendra, Fuel Geology, Vishal Publishing Co.

Course outcomes (COs):

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

CO1	To gain the knowledge of different chemical constituents of oil and gas, Oil field brines, their classification, importance and alteration
CO2	To understand the knowledge about geophysical and geological methods for oil and gas exploration.
CO3	To classify and identify different petroliferous basins of India and their associated lithology, Stratigraphy, structure.
CO4	To differentiate the structures like folds, faults, joints, unconformity, salt domes and Oil and gas fields associated with buried hills
CO5	To estimate the fixed carbon ration in the hydrocarbon and the calorific valve
CO6	Write about the distribution of important petroliferous basins of India and world

CO-PO-PSO Mapping

Course	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15	PO 16	PO 17	PO 18	PO 19	PO 20	PO 21	PO 22	PO 23	PO 24	PO 25	PO 26	PO 27	PO 28	PO 29	PO 30	PO 31	PO 32	PO 33	PO 34	PO 35	PO 36	PO 37	PO 38	PO 39	PO 40	PO 41	PO 42	PO 43	PO 44	PO 45	PO 46	PO 47	PO 48	PO 49	PO 50	PO 51	PO 52	PO 53	PO 54	PO 55	PO 56	PO 57	PO 58	PO 59	PO 60	PO 61	PO 62	PO 63	PO 64	PO 65	PO 66	PO 67	PO 68	PO 69	PO 70	PO 71	PO 72	PO 73	PO 74	PO 75	PO 76	PO 77	PO 78	PO 79	PO 80	PO 81	PO 82	PO 83	PO 84	PO 85	PO 86	PO 87	PO 88	PO 89	PO 90	PO 91	PO 92	PO 93	PO 94	PO 95	PO 96	PO 97	PO 98	PO 99	PO 100	PO 101	PO 102	PO 103	PO 104	PO 105	PO 106	PO 107	PO 108	PO 109	PO 110	PO 111	PO 112	PO 113	PO 114	PO 115	PO 116	PO 117	PO 118	PO 119	PO 120	PO 121	PO 122	PO 123	PO 124	PO 125	PO 126	PO 127	PO 128	PO 129	PO 130	PO 131	PO 132	PO 133	PO 134	PO 135	PO 136	PO 137	PO 138	PO 139	PO 140	PO 141	PO 142	PO 143	PO 144	PO 145	PO 146	PO 147	PO 148	PO 149	PO 150	PO 151	PO 152	PO 153	PO 154	PO 155	PO 156	PO 157	PO 158	PO 159	PO 160	PO 161	PO 162	PO 163	PO 164	PO 165	PO 166	PO 167	PO 168	PO 169	PO 170	PO 171	PO 172	PO 173	PO 174	PO 175	PO 176	PO 177	PO 178	PO 179	PO 180	PO 181	PO 182	PO 183	PO 184	PO 185	PO 186	PO 187	PO 188	PO 189	PO 190	PO 191	PO 192	PO 193	PO 194	PO 195	PO 196	PO 197	PO 198	PO 199	PO 200	PO 201	PO 202	PO 203	PO 204	PO 205	PO 206	PO 207	PO 208	PO 209	PO 210	PO 211	PO 212	PO 213	PO 214	PO 215	PO 216	PO 217	PO 218	PO 219	PO 220	PO 221	PO 222	PO 223	PO 224	PO 225	PO 226	PO 227	PO 228	PO 229	PO 230	PO 231	PO 232	PO 233	PO 234	PO 235	PO 236	PO 237	PO 238	PO 239	PO 240	PO 241	PO 242	PO 243	PO 244	PO 245	PO 246	PO 247	PO 248	PO 249	PO 250	PO 251	PO 252	PO 253	PO 254	PO 255	PO 256	PO 257	PO 258	PO 259	PO 260	PO 261	PO 262	PO 263	PO 264	PO 265	PO 266	PO 267	PO 268	PO 269	PO 270	PO 271	PO 272	PO 273	PO 274	PO 275	PO 276	PO 277	PO 278	PO 279	PO 280	PO 281	PO 282	PO 283	PO 284	PO 285	PO 286	PO 287	PO 288	PO 289	PO 290	PO 291	PO 292	PO 293	PO 294	PO 295	PO 296	PO 297	PO 298	PO 299	PO 300	PO 301	PO 302	PO 303	PO 304	PO 305	PO 306	PO 307	PO 308	PO 309	PO 310	PO 311	PO 312	PO 313	PO 314	PO 315	PO 316	PO 317	PO 318	PO 319	PO 320	PO 321	PO 322	PO 323	PO 324	PO 325	PO 326	PO 327	PO 328	PO 329	PO 330	PO 331	PO 332	PO 333	PO 334	PO 335	PO 336	PO 337	PO 338	PO 339	PO 340	PO 341	PO 342	PO 343	PO 344	PO 345	PO 346	PO 347	PO 348	PO 349	PO 350	PO 351	PO 352	PO 353	PO 354	PO 355	PO 356	PO 357	PO 358	PO 359	PO 360	PO 361	PO 362	PO 363	PO 364	PO 365	PO 366	PO 367	PO 368	PO 369	PO 370	PO 371	PO 372	PO 373	PO 374	PO 375	PO 376	PO 377	PO 378	PO 379	PO 380	PO 381	PO 382	PO 383	PO 384	PO 385	PO 386	PO 387	PO 388	PO 389	PO 390	PO 391	PO 392	PO 393	PO 394	PO 395	PO 396	PO 397	PO 398	PO 399	PO 400	PO 401	PO 402	PO 403	PO 404	PO 405	PO 406	PO 407	PO 408	PO 409	PO 410	PO 411	PO 412	PO 413	PO 414	PO 415	PO 416	PO 417	PO 418	PO 419	PO 420	PO 421	PO 422	PO 423	PO 424	PO 425	PO 426	PO 427	PO 428	PO 429	PO 430	PO 431	PO 432	PO 433	PO 434	PO 435	PO 436	PO 437	PO 438	PO 439	PO 440	PO 441	PO 442	PO 443	PO 444	PO 445	PO 446	PO 447	PO 448	PO 449	PO 450	PO 451	PO 452	PO 453	PO 454	PO 455	PO 456	PO 457	PO 458	PO 459	PO 460	PO 461	PO 462	PO 463	PO 464	PO 465	PO 466	PO 467	PO 468	PO 469	PO 470	PO 471	PO 472	PO 473	PO 474	PO 475	PO 476	PO 477	PO 478	PO 479	PO 480	PO 481	PO 482	PO 483	PO 484	PO 485	PO 486	PO 487	PO 488	PO 489	PO 490	PO 491	PO 492	PO 493	PO 494	PO 495	PO 496	PO 497	PO 498	PO 499	PO 500	PO 501	PO 502	PO 503	PO 504	PO 505	PO 506	PO 507	PO 508	PO 509	PO 510	PO 511	PO 512	PO 513	PO 514	PO 515	PO 516	PO 517	PO 518	PO 519	PO 520	PO 521	PO 522	PO 523	PO 524	PO 525	PO 526	PO 527	PO 528	PO 529	PO 530	PO 531	PO 532	PO 533	PO 534	PO 535	PO 536	PO 537	PO 538	PO 539	PO 540	PO 541	PO 542	PO 543	PO 544	PO 545	PO 546	PO 547	PO 548	PO 549	PO 550	PO 551	PO 552	PO 553	PO 554	PO 555	PO 556	PO 557	PO 558	PO 559	PO 560	PO 561	PO 562	PO 563	PO 564	PO 565	PO 566	PO 567	PO 568	PO 569	PO 570	PO 571	PO 572	PO 573	PO 574	PO 575	PO 576	PO 577	PO 578	PO 579	PO 580	PO 581	PO 582	PO 583	PO 584	PO 585	PO 586	PO 587	PO 588	PO 589	PO 590	PO 591	PO 592	PO 593	PO 594	PO 595	PO 596	PO 597	PO 598	PO 599	PO 600	PO 601	PO 602	PO 603	PO 604	PO 605	PO 606	PO 607	PO 608	PO 609	PO 610	PO 611	PO 612	PO 613	PO 614	PO 615	PO 616	PO 617	PO 618	PO 619	PO 620	PO 621	PO 622	PO 623	PO 624	PO 625	PO 626	PO 627	PO 628	PO 629	PO 630	PO 631	PO 632	PO 633	PO 634	PO 635	PO 636	PO 637	PO 638	PO 639	PO 640	PO 641	PO 642	PO 643	PO 644	PO 645	PO 646	PO 647	PO 648	PO 649	PO 650	PO 651	PO 652	PO 653	PO 654	PO 655	PO 656	PO 657	PO 658	PO 659	PO 660	PO 661	PO 662	PO 663	PO 664	PO 665	PO 666	PO 667	PO 668	PO 669	PO 670	PO 671	PO 672	PO 673	PO 674	PO 675	PO 676	PO 677	PO 678	PO 679	PO 680	PO 681	PO 682	PO 683	PO 684	PO 685	PO 686	PO 687	PO 688	PO 689	PO 690	PO 691	PO 692	PO 693	PO 694	PO 695	PO 696	PO 697	PO 698	PO 699	PO 700	PO 701	PO 702	PO 703	PO 704	PO 705	PO 706	PO 707	PO 708	PO 709	PO 710	PO 711	PO 712	PO 713	PO 714	PO 715	PO 716	PO 717	PO 718	PO 719	PO 720	PO 721	PO 722	PO 723	PO 724	PO 725	PO 726	PO 727	PO 728	PO 729	PO 730	PO 731	PO 732	PO 733	PO 734	PO 735	PO 736	PO 737	PO 738	PO 739	PO 740	PO 741	PO 742	PO 743	PO 744	PO 745	PO 746	PO 747	PO 748	PO 749	PO 750	PO 751	PO 752	PO 753	PO 754	PO 755	PO 756	PO 757	PO 758	PO 759	PO 760	PO 761	PO 762	PO 763	PO 764	PO 765	PO 766	PO 767	PO 768	PO 769	PO 770	PO 771	PO 772	PO 773	PO 774	PO 775	PO 776	PO 777	PO 778	PO 779	PO 780	PO 781	PO 782	PO 783	PO 784	PO 785	PO 786	PO 787	PO 788	PO 789	PO 790	PO 791	PO 792	PO 793	PO 794	PO 795	PO 796	PO 797	PO 798	PO 799	PO 800	PO 801	PO 802	PO 803	PO 804	PO 805	PO 806	PO 807	PO 808	PO 809	PO 810	PO 811	PO 812	PO 813	PO 814	PO 815	PO 816	PO 817	PO 818	PO 819	PO 820	PO 821	PO 822	PO 823	PO 824	PO 825	PO 826	PO 827	PO 828	PO 829	PO 830	PO 831	PO 832	PO 833	PO 834	PO 835	PO 836	PO 837	PO 838	PO 839	PO 840	PO 841	PO 842	PO 843	PO 844	PO 845	PO 846	PO 847	PO 848	PO 849	PO 850	PO 851	PO 852	PO 853	PO 854	PO 855	PO 856	PO 857	PO 858	PO 859	PO 860	PO 861	PO 862	PO 863	PO 864	PO 865	PO 866	PO 867	PO 868	PO 869	PO 870	PO 871	PO 872	PO 873	PO 874	PO 875	PO 876	PO 877	PO 878	PO 879	PO 880	PO 881	PO 882	PO 883	PO 884	PO 885	PO 886	PO 887	PO 888	PO 889	PO 890	PO 891	PO 892	PO 893	PO 894	PO 895	PO 896	PO 897	PO 898	PO 899	PO 900	PO 901	PO 902	PO 903	PO 904	PO 905	PO 906	PO 907	PO 908	PO 909	PO 910	PO 911	PO 912	PO 913	PO 914	PO 915	PO 916	PO 917	PO 918	PO 919	PO 920	PO 921	PO 922	PO 923	PO 924	PO 925	PO 926	PO 927	PO 928	PO 929	PO 930	PO 931	PO 932	PO 933	PO 934	PO 935	PO 936	PO 937	PO 938	PO 939	PO 940	PO 941	PO 942	PO 943	PO 944	PO 945	PO 946	PO 947	PO 948	PO 949	PO 950	PO 951	PO 952	PO 953	PO 954	PO 955	PO 956	PO 957	PO 958	PO 959	PO 960	PO 961	PO 962	PO 963	PO 964	PO 965	PO 966	PO 967	PO 968	PO 969	PO 970	PO 971	PO 972	PO 973	PO 974	PO 975	PO 976	PO 977	PO 978	PO 979	PO 980	PO 981	PO 982	PO 983	PO 984	PO 985	PO 986	PO 987	PO 988	PO 989	PO 990	PO 991	PO 992	PO 993	PO 994	PO 995	PO 996	PO 997	PO 998	PO 999	PO 1000	PO 1001	PO 1002	PO 1003	PO 1004	PO 1005	PO 1006	PO 1007	PO 1008	PO 1009	PO 1010	PO 1011	PO 1012	PO 1013	PO 1014	PO 1015	PO 1016	PO 1017	PO 1018	PO 1019	PO 1020	PO 1021	PO 1022	PO 1023	PO 1024	PO 1025	PO 1026	PO 1027	PO 1028	PO 1029	PO 1030	PO 1031	PO 1032	PO 1033	PO 1034	PO 1035	PO 1036	PO 1037	PO 1038	PO 1039	PO 1040	PO 1041	PO 1042	PO 1043	PO 1044	PO 1045	PO 1046	PO 1047	PO 1048	PO 1049	PO 1050	PO 1051	PO 1052	PO 1053
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M.Sc. Geology

Course code	: MGLS308			
Course Name	: Environment Geology			
Semester /Year	: 3 rd			
	L	T	P	C
	3			3

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 1:- Definition; History of Environmental Geology; Environmental Geology and Commercial reality; The tools of the Environmental geologist; Critical thinking about the environment;

Unit 2:- GEOLOGICAL RESOURCES: Economic mineral resources; Construction resources; Water resources; Aesthetic and Scientific geological resources (aesthetic, cultural and scientific importance of Geology).

Unit 3:- NATURAL HAZARDS: Exogenic hazards; Endogenic hazards; Engineering geology in extreme events.

Unit 4:- 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;

Unit 5:- ENVIRONMENTAL GEOLOGY: AN URBAN CONCEPT: Urban Environments; Urban planning and geology;

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

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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

CO-PO-PSO Mapping

Course	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	2	1	1	1	1	1	2	1	2	1	1	1	3	3	1	2	2
CO2	1	2	1	2	1	1	1	1	1	2	1	2	1	3	2	1	1
CO3	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3	2
CO4	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3	1
CO5	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3	2
CO6	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3	1

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

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M.Sc. Geology
4th Semester

Course code : MGLC401				
Course Name : Geohydrology				
Semester /Year : 4 th				
	L	T	P	C
	3			3

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

Course Objectives: The objectives of this course are

1. To understand the Groundwater fluctuation: types, controlling factors Groundwater wells, types and methods Groundwater chemistry: Components of groundwater; Salinity in Groundwater Seawater intrusion and Classification and Indian salinity hazards, Artificial recharge of groundwater, Ground water Exploration: Surface geophysical methods, Groundwater Management and Development, Groundwater pollution: Arsenic, fluoride and Nitrate.

Course Content:

Unit 1:-Occurrence and distribution of groundwater, hydrological cycle, hydrological properties of rocks, water table fluctuations.

Unit 2:-Theory of groundwater flow, Darcy's law and its application, determination of permeability, types of well; types and characteristics of Aquifers.

Unit 3:-Groundwater quality, problems of arsenic and fluorides, groundwater contaminations, groundwater conditions of India.

Unit 4:-Methods of artificial groundwater recharge, method of rainwater harvesting, groundwater legislation.

Unit 5:-Geological and geophysical methods - electrical (resistivity), seismic, gravity and magnetic methods.

Text Books:

- TB1. Todd, D.K. (1980): Ground Water Hydrology, John Wiley & Sons, New York.
TB2. Bouver, H. (1978): Groundwater Hydrology, McGraw Hill

Reference Books:

- RB1. Davies, S.N. and De-West, R.J.N. (1966): Hydrology, John Wiley & Sons, New York.
RB2. Deming, D. (2002). Introduction to hydrogeology. McGraw Hill

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

CO1	To gain knowledge, comprehend the hydrologic cycle and related major water quantity and quality challenges and their relevance to human health and well-being, ecosystems.
CO2	To understand the role of hydrology, Aquifer, water resources management and the legal and economic frameworks associated with addressing these challenges.
CO3	To apply comprehend the chemistry of water and biological phenomena as related to water quality and contaminant transport in surface water and groundwater that provide for drinking water, agriculture, ecosystems, and industry.
CO4	Analyse Groundwater Quality with different methods.
CO5	Distinguish between various Aquifers and Darcy's law and its application, determination of permeability, unconfined, confined flow condition
CO6	To explore groundwater regime through various geophysical methods

CO-PO-PSO Mapping

Course	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	2	1	1	1	1	1	2	1	2	1	1	1	3	3	1	2	2
CO2	1	2	1	2	1	1	1	1	1	2	1	2	1	3	2	1	1
CO3	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3	2
CO4	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3	1
CO5	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3	2
CO6	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3	1

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

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M.Sc. Geology

Course code	: MGLC402			
Course Name	: Ore Genesis and Indian Mineral Deposits			
Semester /Year	: 4th			
	L	T	P	C
	3			3

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

Course Objectives: The objectives of this course are

1. This course will provide basic insights into the genesis of economic mineral deposits that are imperative for modern sustainable societies.
2. To understand the Ore forming processes, Tectonics and ore formation, Ore texture and genesis. Phase equilibria of sulphide and oxide, Ore in igneous rocks, metamorphic rocks, sedimentary placer deposits, Indian occurrence of metallic and non-metallic ores, Raw materials used in different industries and their specifications, metallogenic epochs and province of Indian sub continents, mineral Para genesis etc.
3. To understand the Indian mineral policy and regulations, future aspects and Uttarakhand mineral status.

Course Content:

Unit 1:-Processes of ore formation, Structural, physico-chemical and stratigraphic controls of ore localization, wall rock alteration, Ore bearing fluids, their origin and migration, mineralization and tectonism.

Unit 2:-Indian distribution and characters of metallic ore deposits of copper, gold, lead and zinc, aluminum, magnesium, iron, manganese, chromium, tungsten, molybdenum.

Unit 3:-Indian distribution and characters of non-metallic minerals: coal and petroleum, mica, asbestos, barite, graphite, gypsum, refractories, abrasives, ceramics, fertilizers, cement, paints- pigments and gem stones.

Unit 4:-Metallogenic epochs and provinces of Indian subcontinent, Para genesis, zoning, mineral deposits of Indian oceans.

Unit 5:-National mineral policy and mineral conservation; India's status in mineral production, international aspects, future prospects, strategic, critical and essential minerals, mineral resources of Uttarakhand.

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Text Books:

- TB1. Karanth, R.V. (2000): Gems and gem Industry in India, Geol. Soc. India, Bangalore.
 TB2. Krishnaswamy, S. (1979): India's Mineral Resources, Oxford and IBH Co.
 TB3. Tiwari, S. K.: Ore Geology, economic mineral and mineral economics Vol.-2.
 TB4. Evans, A.M. (1993): Ore Geology and Industrial Minerals, Blackwell.
 TB5. Stanton, R.L. (1972): Ore Petrology, McGraw Hill.

Reference Books:

- RB1. Barnes, H.L. (1979): Geochemistry of Hydrothermal Ore Deposits, John Wiley.
 RB2. Guilbert, J.M. and Park, Jr.C.F. (1986): The Geology of Ore Deposits, Freeman.
 RB3. Mookherjee, A. (2000): Ore Genesis-A Holistic Approach, Allied Publisher.
 RB4. Jensen and Bateman Economic minerals
 RB5. U.Prasad -Economic Mineral Deposits

Course outcomes (COs):

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

CO1	To gain the knowledge and identify the ore deposits in wide variety of geological environments and how they formed and how they react with surrounding and how the natural barrier controls them in suitable reservoir.
CO2	To understand the wide variety of metalliferous ore forming processes.
CO3	To classify the distribution of metallic ore and non-metallic ores
CO4	To compare the metallogenic epochs and provinces of Indian subcontinent, Para genesis, zoning
CO5	Differentiate between strategic, critical and essential minerals and mineral resources of Uttarakhand.
CO6	Write about the concept of mineral policy, production, future aspect and mineral deposits of Indian oceans

CO-PO-PSO Mapping

Course	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	2	1	1	1	1	1	2	1	2	1	1	1	3	3	1	2	2
CO2	1	2	1	2	1	1	1	1	1	2	1	2	1	3	2	1	1
CO3	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3	2
CO4	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3	1
CO5	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3	2
CO6	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3	1

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

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M.Sc. Geology

Course code	: MGLL403			
Course Name	: Lab Course based on C401&C402			
Semester /Year	: 4 th			
	L	T	P	C
				4

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

Course Objectives: The objectives of this course are

1. Upon completion of this course, the student will be able to Analysis of hydrographs and estimation of infiltration capacity, contour maps and estimation of permeability and chemical analysis of water.
2. Upon completion of this course, the student will be able to identify the economic minerals in hand specimen.
3. Study of geological maps and sections of important oilfields of India and world and calculation of oil reserves.

Course Content:**Unit1- Geohydrology**

- Numerical problems solve based on theory.
- Study hydrological properties of rock.
- Study water quality Index.

Unit2- Ore genesis and Indian mineral deposits

- Study of economic minerals in hand specimen.
- Study of geological maps and sections of important oilfields of India and world. Calculation of oil reserves.
- Preparation of mineral maps of India. Graphical representation of production, export and import of important minerals. Calculation of grade and ore reserves. Interpretation of remote sensing data for mineral exploration.

Text Books:

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:

RB2. Practical Handbook of Earth Science by Jane H. Hodgkinson; Frank D.

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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 gain the knowledge of economic minerals in hand specimen. To analyse the delineation of hydrological boundaries on water table, contour maps and estimation of permeability.
CO2	Study of geological maps and sections of important oilfields of India and world.
CO3	To understand and preparation of mineral maps of India. Graphical representation of production, export and import of important minerals.
CO4	To analysis of hydrographs and estimation of infiltration capacity. Chemical analysis of water in evaluation of aquifer parameters. Step drawdown tests, electric resistivity sounding for delineation of fresh and saline aquifers.
CO5	Exercise on ground water exploration using remote sensing techniques.
CO6	Calculation of oil reserves Calculation of grade and ore reserves. Interpretation of remote sensing data for mineral exploration

CO-PO-PSO Mapping

Cours e	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	POI 0	POI 1	POI 2	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	2	1	1	1	1	1	2	1	2	1	1	1	3	3	1	2	2
CO2	1	2	1	2	1	1	1	1	1	2	1	2	1	3	2	1	1
CO3	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3	2
CO4	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3	1
CO5	1	3	1	1	2	1	2	1	1	3	1	1	2	3	1	3	2
CO6	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3	1

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

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M.Sc. Geology

Course code	: MGLE404			
Course Name	: Geological Field Training Tour			
Semester /Year	: 4 th			
	L	T	P	C
				4

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

Course Objectives: The objectives of this course are

1. Geological field work is important to understand rocks in their natural environment and their natural relationship to one another.
2. It seeks to describe and explain the surface feature and underground structure of the lithosphere based upon observations and inferences.

Course Content:

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

The field work should be maximum 07 days

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 to

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 analyse 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.

Kripalika

S

Shalin

AS

Ajinkya

CO-PO-PSO Mapping

Course	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	2	1	1	1	1	1	2	1	2	1	1	1	3	3	1	2	2
CO2	1	2	1	2	1	1	1	1	1	2	1	2	1	3	2	1	1
CO3	1	3	2	1	2	2	2	2	1	3	2	1	2	3	1	3	2
CO4	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3	1
CO5	1	3	1	1	2	3	2	1	1	3	1	1	2	3	1	3	2
CO6	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3	1

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

M.Sc. Geology

Course code	: MGLE405			
Course Name	: Project/Dissertation			
Semester /Year	: 4 th			
	L	T	P	C
				6

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 second semester based on the expertise available in the Department. The project oriented dissertation must be submitted by the end of fourth semester. During the course of completion of dissertation work the students will be required to complete various assignments given to them by their respective supervisors or the Head of Department for the purpose of their evaluation. Beside classroom seminars, the students will have to present their dissertation work in the form of seminar before the board of examiners including the supervisors which will be followed by viva voce examination

Kripa

A. Shrivastava

A. Singh

A. Singh

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

CO1	To gain Knowledge and develop awareness and interest towards research.
CO2	To understand the development of scientific temperament.
CO3	Apply Principles of research design to solve the problems in the field of research.
CO4	Analyse critically various research problem
CO5	Evaluate the links between theory and methods within their field of study.
CO6	Create various research solutions.

CO-PO-PSO Mapping

Course	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	2	1	1	1	1	1	2	1	2	1	1	1	3	3	1	2	2
CO2	1	2	1	2	1	1	1	1	1	2	1	2	1	3	2	1	1
CO3	1	3	2	1	2	2	2	2	1	3	2	1	2	3	1	3	2
CO4	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3	1
CO5	1	3	1	1	2	3	2	1	1	3	1	1	2	3	1	3	2
CO6	2	1	2	2	1	1	3	1	2	1	2	2	1	3	2	3	1

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

*Kripal**Sulini**[Signature]**Ajaya*