

SHRI GURU RAMRAI UNIVERSITY

DEHRADUN (SGRRU)

PATEL NAGAR DEHRADUN

DEPARTMENT OF GEOLOGY

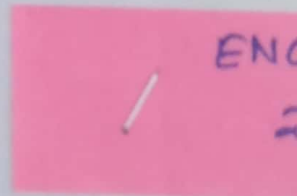
PRE-Ph.D course work in Geology

(Courses effective from Academic Year)  
(2017-18)



SYLLABUS OF COURSES

*Ajay B. Verma*  
*Sharma*      *Singh*



# **SHRI GURU RAM RAI UNIVERSITY**

(Estd. by Govt. of Uttarakhand, vide Shri Guru Ram Rai University Act no. 03 of 2017)



## **Syllabus of Pre-Ph.D. Geology**

**Effective from Academic Session  
2017-2018**

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Patel Nagar, Dehradun, Uttarakhand



- c) The sessional test will carry 40% of total marks for the course. The marks of the two sessional tests shall be taken into account for the computation of grades.
- d) There shall be one semester examination of 2 hours duration carrying 60% of marks in each course covering the entire syllabus prescribed for the course at the end of the semester only. The end semester examination shall be normally a written/laboratory based examination or presentation/seminar. The end semester examination and evaluation shall be conducted by the University.

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CORE COURSE

PGLC 101- Geology First

- Unit 1: some fundamental concept of general geology and geomorphology.
- Unit 2: structure and tectonic: concept of stress and strain and behavior of rocks.
- Unit 3: idea of x-ray crystallography, crystal optics, silicates structures.
- Unit 4: concept, methods in mega and micro-paleontology and stratigraphy.

PGLC 102 -Geology Second

- Unit 1: crystallization of magma, petrological characteristic of igneous rocks, sedimentary and metamorphic rocks; concept of depositional environment and metamorphism.
- Unit 2: ore genesis; Indian distribution and characteristics of ore deposits, mineral economics and mineral policy.
- Unit 3: engineering properties of rocks: application of geology in engineering projects, geohazards, hydrological properties of rocks, distribution, movement and occurrence of ground water quality analysis.

PGLC 103- Geology Third

(candidates may choose any one of the following Units.)

- Unit 1: **Advanced mineralogy:** Laboratory aspects of RI determination, modal analysis, reflectivity, micro hardness, cathode luminescence, chemical and x-ray analysis and their application in natural minerals, systems and assemblages.
- Unit 2: **Sedimentology:** Selected topic in deposition environments, tectonic control, diagenesis and petrology of plastic and sedimentary deposits.
- Unit 3: **Petrology:** Modern rock in pure and applied petrology, including recent development in research methodology and instrumentation concerning the investigation of crustal inorganic and/ or organic material.
- Unit 4: **Metamorphism:** problem of regional metamorphism illustrated by Precambrian basement terrain and more recent orogenic belt, crustal evolution-pressure-temperature-time-deformation history of metamorphic belts. Review of experimental works in
- Unit 5: **stratigraphy and paleontology:** stratigraphic sequence, depositional frame work, general nature of paleontology problem, functional morphology analysis of biostratigraphy, SEM analysis, sequence stratigraphy and palaeomagnetism.
- Unit 6: **Geochemistry:** Modern work in pure and applied geochemistry including element distribution and migration in igneous, sedimentary and metamorphic rocks, hydrocarbon occurrence and organic studies.
- Unit 7: **Quaternary geology and geomorphology:** Evolution of land forms in the context of tectonics and climate, various techniques used in the study of quaternary

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records, understanding the quaternary deposits in India, elementary ideas about modern techniques of geochronology.

**Unit 8: Geohydrology:** type of aquifers, modern methods of characterization of aquifers, water chemistry and its application in monitoring the ground water quality.

**Unit 9: Environmental geology:** current environmental issues viz. water, air, soil contamination/ pollution issues, causes, remedial measures. Geological hazards: seismicity, landslides, their causes and migration, land use planning development, use remote sensing and GIS in the preparation of hazards zonation maps.

**Unit 10: Structure and tectonics:** relationship between internal and external stress and the resultant strain feature in rocks including mathematical analysis and analogue computer studies, geodynamics and deep earth processes, Himalayan tectonics.

**Unit 11: Economics geology:** Processes of ore formation, structural and stratigraphic control of mineralization, and tectonics, distribution of metallic and non-metallic ore deposits including coal and hydrocarbons, methods of surface and sub-surface prospecting.

**Unit 12: Application of GIS and remote sensing techniques:** Training on the use of RS/GIS software viz. ARC GIS, Global Mapper, IRDAS imagine etc. digital representation and analysis of vector and raster geographic data, topology and spatial relationship, techniques of digital terrain analysis, visualization of vector and raster data and basic cartographic techniques, geoprocessor.

#### PGLE104 –Geology Fourth

**Unit I: (A) Research Methodology:** Introduction-objectives and significance of research, research methodology versus methodology.

**(B) Research and scientific methods:** Importance of knowing how research is done, research process, problems encountered by researchers in India, journal reading techniques, defining research problem, national and international status of the research problem selected by the candidates.

**(C) Significance of report writing, Steps in report writing, Precaution for writing a research report, techniques of oral presentation.**

**Unit II: Computer application and statistical method:** Practical training, laboratory techniques, computer and software application.

**Unit III: Review of literature and assignment.**

**Unit IV: Field course:** Field course of two weeks duration which may include section measurements (out crop logs) of relatively unformed and deformed sequences, mapping on scale on 1:50,000 scale, sampling plan, collection of samples, field documentation, techniques of fossil excavation etc.

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**Unit V: Presentation/Seminar:** based on the above guidelines, the candidate will deliver at least two presentations in front of departmental committee on his research topic and prepare the final synopsis in consultation with his supervisor.

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# SHRI GURU RAM RAI UNIVERSITY

## PATEL NAGAR DEHRADUN, UTTARAKHAND

(Established under Shri Guru Ram Rai University Act No.3 of 2017)



## DEPARTMENT OF GEOLOGY

Course Content & Syllabus

of

M.Sc. Geology (Semester system)

WEF: 2017-18 Batch

Ajay/B.S.

W.S.

Shelini

W.S.



## M.Sc. Geology

## Semester-1(July-December)

Course No.	Core Courses	L	T	P	Credit
MGLC101	General Geology and Geomorphology	4	0	0	4
MGLC102	Structural Geology	4	0	0	4
MGLC103	Mineralogy	4	0	0	4
MGLC104	General and Invertebrate Paleontology	4	0	0	4
MGLL105	Lab Course I based on C101&C102	0	0	3	3
MGLL106	Lab Course II based on C103&C104	0	0	3	3
	<b>Total credits</b>				22

## Semester-2(January-June)

Course No.	Core Courses	L	T	P	Credit
MGLC201	Crystallography	4	0	0	4
MGLC202	Geotectonics	4	0	0	4
MGLC203	Micropaleontology, Vertebrate Paleontology and Palaeobotany	4	0	0	4
MGLC204	Stratigraphy	4	0	0	4
MGLC205	Geological Field Training tour	0	0	3	3
MGLL206	Lab Course based on C201 to C204	0	0	3	3
	<b>Total credits</b>				22

## Semester-3(July-December)

Course No.	Core Courses/ Elective	L	T	P	Credit
MGLC301	Igneous Petrology & Geochemistry	4	0	0	4
MGLC302	Engineering Geology	4	0	0	4
MGLL303	Lab Course I based on C301&C302	0	0	3	3
MGLE304	Sedimentary and Metamorphic Petrology	4	0	0	4
MGLE305	Mineral Exploration and Mining	4	0	0	4
MGLL306	Lab Course II based on E304&E305	0	0	3	3
MGLS307	Petroleum Geology				3
	<b>Total credits (excluding Self-study Course)</b>				22

## Semester-4(January-June)

Course No.	Core Courses/ Elective	L	T	P	Credit
MGLC401	Geohydrology	4	0	0	4
MGLC402	Ore Genesis and Indian mineral deposits	4	0	0	4
MGLL403	Lab Course based on C401&C402	0	0	3	3
MGLE404	Geological Field Training tour	0	0	3	3
MGLE405	Project/ Dissertation	0	0	6	6
	<b>Total credits</b>				20
	<b>Grand Total credits (excluding Self-study Course)</b>				86

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Semester-1

MGLC101: General Geology and Geomorphology

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

Unit 2:- Elementary idea of cosmogeny, Interior of earth, geochronology, theories of isostasy, ocean bottom topography cycle of erosion, landscape evolution, 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, landforms of Himalayas.

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

**Books recommended**

- Thornbury, W.D. (1980): Principle of Geomorphology, Wiley Eastern Ltd. New York.
- Holmes, A. (1992): Holmes Principles of Physical Geology, Chapman & Hall publ.
- Halis, J.R. (1983): Applied Geomorphology.
- Sharma, H.S. (1990): Indian Geomorphology, Concept Publishing Co. New Delhi.
- Agrawal, L. C. Introduction to Geomorphology.
- Gass, I.G. et al. (1982): Understanding the Earth, Artemis Press (Pvt.) Ltd. U.K.
- Windley, B. (1973): The Evolving continents, John Wiley & Sons publ.
- Condie, Kent. C. (1982): Plate Tectonics & Crustal Evolution, Pergamon Press .
- Savindra singh , geomorphology, pravalika pub. Allahabad.

MGLC102: Structural Geology

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.

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**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, Mylonites and Cataclastics.

**Unit 5:-** Basic idea about petrofabrics and use of Universal stage, diapers and salt domes, cleavage, lineation.

**Books recommended**

Davies, A.Z.: Structural Geology.

Ghosh, S. K.: Structural Geology, Fundamental and Modern Concepts, Pergamon Press.

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

Ramsay J.G. & Huber M. I. (1983): The Techniques of Modern Structural Geology-I, Strain Analysis, Academic Press.

Ramsay J.G. & Huber M. I., (1987): The Techniques of Modern Structural Geology-II, Strain Analysis, Academic Press.

Hobbs, B.E., Means, W.D. & Williams, P.F. (1976): An outlines of Structural Geology, John Wiley and Sons publ.

Turner, F.J. & Weiss, L.E. (1963): Structural analysis of Metamorphic Tectonites, McGraw Hill publ.

Jain, A.K , advance structural analysis, nem chand and bros.

**MGLC103: Mineralogy**

**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

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- d) Inosilicate: pyroxene and amphibole group.
- e) Phyllosilicate: kaolinite group.
- f) Tectosilicate: feldspar group.
- g) quartz and non-silicate: carbonate, oxide, sulphide.

Unit 4:- Properties of uniaxial and biaxial crystal.

**Books Recommended:**

- Moor house, W.W.: Optical Mineralogy.
- Dana, E.S. & Ford, W.E.: A Text book of Mineralogy, Wiley Eastern Ltd.
- Phillips, W.R & Guffen, D.T- Optical mineralogy.
- Barry & Mason- Mineralogy.
- Kerr, P.F.: Optical mineralogy, McGraw Hill publ.
- Deer, W.A, Howie, R.A. & Zussman, J.: An Introduction to rock forming minerals, ELBS & Longman.
- Dexter perkin, optical mineralogy
- Alexander N. winchill, element of optical mineralogy, ulan press pub.
- Babu .S.K and sinha.D.K, mineralogy, CBS pub.

**MGLC104: General and Invertebrate Paleontology**

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

Unit 2:-Biostratigraphy, Paleoecology, origin of life and organic evolution.

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, Echinoidea and Graptolite.

Unit 5:-Zoogeographic provenance, dispersal and extinction.

**Books recommended:**

- Clarkson, E. N.K. (1998): Invertebrate Paleontology and Evolution.
- Smith, A.B. (1994): Systematic and fossil record- Documenting Evolutionary patterns.

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- Stearn, C.W. and Carroll, R.L. (1989); Paleontology the record of life, John Willey Publ.
- Raup, D.M. and Stanley, S.M (1985) Principles of Paleontology (CBS Publication).
- Jain, P.C. & Anantharaman, M.S., 1983. Paleontology: Evolution & Animal Distribution. Vishal
- Henry Woods, invertebrate paleontology,
- Shrock and Twen Hofel, principle of invertebrate paleontology,

**MGLL105: Lab Course I based on C101 & C102**

**(MGLC101): General Geology and Geomorphology**

Analysis of geomorphological features from various morphogenetic regions of India; preparation of geomorphological maps on different scales (1:2, 50,000 & 1:50,000).

Preparation of longitudinal and cross valley profiles.

Altimetric analysis, hypsometric analysis, exercises related to measurements of runoff dynamics, sediment and solute dynamics.

• Morphometry of drainage basins, analysis of orientation structures.

**(MGLC102): Structural Geology**

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

**MGLL106: Lab Course II based on C103 & C104**

**(MGLC103): Mineralogy**

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

**(MGLC104): General & Invertebrate Paleontology**

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

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Semester- II

MGLC201: Crystallography

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.

**Books recommended:**

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

MGLC202: Geotectonics

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

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:- Palaeo-magnetism, Polar Wandering and reversal of earth's magnetic field.

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

**Books recommended**

- Condie Kent, C. (1989): Plate Tectonics and Crustal Evolution.
- W. J. Kious & Robert I.T.: This dynamic of Earth: the story of Plate Tectonics USGS publ.
- Moores, E. & Twiss, R.J., 1995: Tectonics. Freeman publ.
- Keary, P. & Vine, F.J. 1990: Global Tectonics. Blackwell scientific publ.

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- Storetvedt, K.N. 1997: Our Evolving Planet. Earth History in new perspective.
- Valdiya, K.S. 1998: Dynamics Himalaya. Univ. Press.

**MGLC203: Micropaleontology, vertebrate paleontology and Palaeobotany**

**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.

**Books recommended:**

- Romer, A.S. 1966. Vertebrate Paleontology, Chicago Univ. Press.
- Swinnerton, H.H. (1950) An outline of palaeontology.
- Arnold, C.A. (1947) An Introduction to palaeobotany, Mc Graw Hill.
- Armstrong, H. & Brasier M. (2005): Micro fossils. Black Well pub.
- Colbert, E.H.(1984) Evolution of the vertebrates. Willey Eastern Ltd.

**MGLC204: Stratigraphy**

**Unit 1:-** Principle of Stratigraphy & Geological time scale, stratigraphic correlation, nomenclature of modern stratigraphic code, Walther's Law, Basic principles of seismic stratigraphy, sequence Stratigraphy and magneto stratigraphy.

**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), Reconstruction of paleogeography and palaeoclimates.

**Books recommended**

- Dunbar, C.O. & Rodgers, J. (1957): Principles of Stratigraphy, John Wiley & Sons.
- Krumbein, W. C. & Sloss, L.L. (1963): Stratigraphy and sedimentation.

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- Freeman, W. H. & Kummel, Co. (1961): History of the earth.
- Hollis D. Hedberg (Ed.) International stratigraphic guide - International sub commission on stratigraphic classification of IUGS commission on stratigraphy John Wiley and Sons
- Naqvi, S.M. & Rogers, J.J.W. (1987): Precambrian Geology of India, Oxford Univ. Press.
- Schoch, Robert, M. (1989): Stratigraphy-Principles and Methods, Van Nostrand Reinhold, New York.
- Kumar, R. (1984): Fundamentals of Historical Geology & Stratigraphy of India.
- Krishnan, M.S. (1982): Geology of India and Burma, C.B.S. Publishers & Distributors, Delhi.
- Valdiya, K.S. (2009): The Making Of India: Geodynamic Evolution. Macmillan Publishers India
- Ramakrishnan M. and Vaidyanadhan,(2008 &2010) Geology of India (Vol. 1 & 2), GSI pub.

MGLC205: Geological field mapping and 3 days tour

MGLL206: Lab Course based on C201 to C204

(MGLC201): Crystallography

Crystal model and projection

(MGLC202): Geotectonics

Stereographic presentation of structural data

(MGLC203): Micropaleontology, vertebrate paleontology and Palaeobotany

Study of important Microfossils,

Study of Vertebrate fossils and Gondwana Flora

(MGLC204): Stratigraphy

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

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Semester-IIIMGLC301: Igneous Petrology & Geo Chemistry

**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).

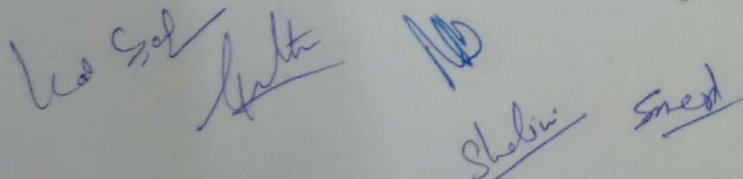
**Unit 3:-**Texture and structures, IUGS classification of the volcanic and plutonic Igneous rocks, and ophiolite

**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.

**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.

**Books recommended**

- Gupta, A.K. (1998): Igneous Rocks Allied Publishers Ltd., New Delhi.
- Jackson: Textbook of lithology.
- Winter, J.D. (2001): An Introduction to Igneous and Metamorphic Petrology
- McBirney, A.R. (1984): Igneous Petrology, Freeman Cooper & Co. California.
- Phillips A.: Introduction to igneous and metamorphic petrology, Prentice Hall Pub.
- Turner, F.J. & Verhoogen, J.: Igneous & Metamorphic petrology CBS Publications.
- Bose, M.K. (1997): Igneous Petrology, World Press, Kolkatta.
- Best, Myron G. (2002): Igneous and Metamorphic Petrology, Blackwell Science.
- Mason, geochemistry
- Krauskopf, geochemistry



MGLC302: Engineering Geology

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. Bridges – types and foundation problems, influence of geological conditions on foundation and design of buildings.

**Books recommended:**

- Krynine D. P. & Judd W. R. (1998): Principles of engineering geology & geo-techniques.
- Gupta, H. K. & Rastogi, B. K. (1976): Dams and Earthquakes, Elsevier and Scientific Pub. Co.
- Clarke: Reservoir engineering.
- Bell, F. G. (1983): Fundamentals of engineering geology, Butterworth's, London.
- Schuttz, J.R and Cleaves , A.B.(1951) Geology in Engineering, John Willey and Sons, New York.

MGLL303: Lab Course I based on C301&C302

MGLC301): 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.

(MGLL302): 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.

MGLE304: Sedimentary & Metamorphic Petrology

Unit 1:-Origin of Terrigenous Clastic and Non-Clastic grains; weathering and its products, structure, texture of sedimentary rocks.

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Unit 2:- Petrography and a diagenesis origin of sandstone, limestone, shale, mudstone, arkose, breccia.

Unit 3:- Sedimentary facies, depositional environments, provenance and palaeo-current.

Unit 4:- Factors controlling metamorphism; Texture and structures of metamorphic rocks.

Unit 5:- Metamorphic grades and Index minerals, types of metamorphism, law of thermodynamics and Gibbs Equation.

Unit 6:- Metamorphic Facies : Zeolite, Blue-schist, Green-schist - Amphibolite, Granulite, Eclogite and contact metamorphic facies.

**Books recommended:**

- Pettijohn, F. J. Sedimentary rocks ( McGraw-Hill, New Delhi)
- Blatt, H., Middleton, G and Murray, R., Origin of Sedimentary Rocks, Prentice Hall
- Verma, V. K. And Prasad, C., Sedimentology (Harman Publishing House, New Delhi)
- Collins, J.D., and Thompson, D.B. (1982): Sedimentary structures. George Allen and Unwin, London.
- Pettijohn, F.J. (1975): Sedimentary Rocks. 3<sup>rd</sup> Edn. Harper and Row Publ., New Delhi.
- Tucker, M.E. (1981): Sedimentary Petrology: An Introduction, Wiley & Sons,
- Winter, J.D. (2001): An Introduction to Igneous and Metamorphic Petrology New York.
- Bucher, K. and Martin, F. 2002: Petrogenesis of Metamorphic Rocks, Springer-Verlag, 7<sup>th</sup> Revised Edition.
- Yardley, B.W.D. 1989: An Introduction to Metamorphic petrology, Longman scientific & Technical, New York.
- Spry, A. 1976: Metamorphic Texture, Pergamon Press.

**MGLE305: Mineral Exploration and Mining Geology**

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.

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**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.

**Books recommended**

- P.K. Banerjee and S. Ghosh (1997): Elements of prospecting for non-fuel mineral deposits.  
Bagchi, T.C., Sengupta, D.K. & Rao, S.L.V.N. (1979): Elements of Prospecting and Exploration.  
Sinha, R.K. & Sharma, N.L. (1976): Mineral Economics.  
Arogyaswami, R.N.P. (1996): Courses in Mining Geology

**MGLL306: Lab Course II based on E304&E305**

**(MGLE304): 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.

**(MGLE305): 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.

**MGLS307: Self Study Course**

**Petroleum Geology**

**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.

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Unit 4:-Drilling and well logging for oil, well completion, 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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*Shelini Suresh*

IV Semester

MGLC401: Geohydrology

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; unconfined, confined flow condition, 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, groundwater provinces of India.

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

**Books recommended:**

- Todd, D.K. (1980): Ground Water Hydrology, John Wiley & Sons, New York.
- Bover, H. (1978): Groundwater Hydrology, McGraw Hill.
- Davies, S.N. and De-West, R.J.N. (1966): Hydrology, John Wiley & Sons, New York.
- Deming, D. (2002).Introduction to hydrogeology. McGraw Hill.

MGLC402: Ore genesis and Indian mineral deposits

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, aluminium, 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.

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Unit 4:-Metallogenic epochs and provinces of Indian subcontinent, Paragenesis, 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.

**Books recommended**

Chatterjee, K.K. (1993): An Introduction to Mineral Economics, Wiley Eastern Ltd.

Karant, R.V. (2000): Gems and gem Industry in India, Geol. Soc. India, Bangalore.

Krishnaswamy, S. (1979): India's Mineral Resources, Oxford and IBH Co.

Tiwari, S. K.: Ore Geology, economic mineral and mineral economics Vol.-2.

Evans, A.M. (1993): Ore Geology and Industrial Minerals, Blackwell.

Stanton, R.L. (1972): Ore Petrology, McGraw Hill.

Barnes, H.L. (1979): Geochemistry of Hydrothermal Ore Deposits, John Wiley.

Guilbert, J.M. and Park, Jr.C.F. (1986): The Geology of Ore Deposits, Freeman.

Mookherjee, A. (2000): Ore Genesis-A Holistic Approach, Allied Publisher.

Jensen and Bateman Economic minerals

U.Prasad -Economic Mineral Deposits

**MGLL403: Lab Course based on C401&C402**

**MGLC401: Geohydrology**

- Delineation of hydrological boundaries on water table, contour maps and estimation of permeability.
- 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.
- Exercise on ground water exploration using remote sensing techniques.

**MGLC402: 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.

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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.

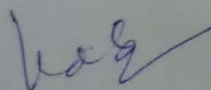
**MGLE404: Geological Field Training**

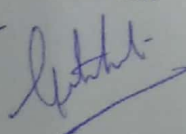
Students will be required to visit geologically important areas including mines, dams, oil fields, fossiliferous sequences and laboratories/institutes of repute and submit a report thereon, under the supervision of a faculty member. The field work should be maximum 07 days.

**MGLE405: Project oriented Dissertation**

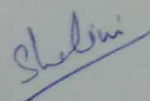
The area of dissertation shall be assigned to the students at the end of second semester based on the expertise available in the Department. The project oriented dissertation must be submitted by the end of fourth semester. During the course of completion of dissertation work the students will be required to complete various assignments given to them by their respective supervisors or the Head of Department for the purpose of their evaluation.

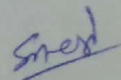
Beside classroom seminars, the students will have to present their dissertation work in the form of seminar before the board of examiners including the supervisors which will be followed by viva voce examination.













# SHRI GURU RAM RAI UNIVERSITY

PATEL NAGAR DEHRADUN, UTTARAKHAND

(Established under Shri Guru Ram Rai University Act No.3 of 2017)



## DEPARTMENT OF GEOLOGY

### Course Content & Syllabus

of

### B. Sc. GEOLOGY

(May be taken as one of the three subjects in ZBG and  
PMG group)

AS PER CBCS SYSTEM (UGC)

WEF: 2017-18 Batch

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# SHRI GURU RAM RAI UNIVERSITY

(Estd. by Govt. of Uttarakhand, vide Shri Guru Ram Rai University Act no. 03 of 2017)



## Syllabus of B.Sc. Geology

Effective from Academic Session  
2017-2018

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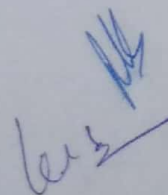
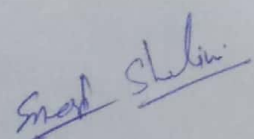
Patel Nagar, Dehradun, Uttarakhand

**B.Sc. Geology****FINAL COURSE STRUCTURE-TOTAL CREDITS (GEOLOGY)- 44+8(AECC)**

Course code	SEMESTER-I	L T P	Credits
GLC101	Physical Geology and Structure Geology	4 0 0	4
GLL101	Lab course based on C101	0 0 2	2
ECC101	Environmental Science/English/MIL Communication	4 0 0	4
	Core credits=6; Compulsory common course=4, Total credits=10	Total Credits	10
Course code	SEMESTER-II	L T P	Credits
GLC201	Mineralogy and Crystallography	4 0 0	4
GLL201	Lab course based on C201	0 0 2	2
ECC201	Environmental Science/English/MIL Communication	4 0 0	4
	Core credits=6; Compulsory common course=4, Total credits=10	Total Credits	10
Course code	SEMESTER-III	L T P	Credits
GLC301	Petrology	4 0 0	4
GLL301	Lab course based on C301	0 0 2	2
GLS302	Geomorphology and Geotectonics	4 0 0	4
(Skill enhancement course opted by student in Geology)	Core credits=6; SEC credit=4, Total credits=10	Total Credits	10
Course code	SEMESTER-IV	L T P	Credits
GLC401	Stratigraphy and Paleontology	4 0 0	4
GLL401	Lab course based on C401	0 0 2	2
	Core credits=6; Total credits=6	Total Credits	06
Course code	SEMESTER-V	L T P	Credits
GLD501	Economic Geology and Hydrology	4 0 0	4
GLL501	Lab course based on C501	0 0 2	2
	DSE credit=6; Total Credit=6	Total Credits	06
Course code	SEMESTER-VI	L T P	Credits
GLD601	Elements of Applied Geology and Photogeology	4 0 0	4
GLL601	Lab course based on C601	0 0 2	2
GLS602	Remote Sensing and Photogeology	4 0 0	4
(SEC may be chosen by the student from one of the subjects opted in B.Sc. Geology programme)	DSE credit=6; SEC credit=4 (if opted); Total Credits=10	Total Credits	10

Patel Nagar, Dehradun, Uttarakhand

Page 2

**B.Sc. Geology****CORE COURSES (CC)****(1<sup>st</sup> to 4<sup>th</sup> semester)****BGLC101**1. Physical Geology and Structural Geology (Theory:04Credits + Practicals: 02 credits = 06 credits)**BGLC201**2. Mineralogy and Crystallography (Theory:04 Credits+Practicals: 02 credits = 06 credits)**BGLC301**3. Petrology (Theory:04 Credits + Practicals: 02 credits = 06 credits)**BGLC401**4. Stratigraphy and Paleontology (Theory:04 Credits + Practicals: 02 credits = 06 credits)**DISCIPLINE SPECIFIC ELECTIVE (DSE)****(5<sup>th</sup> to 6<sup>th</sup> semester)****BGLD501**1. Economic Geology and Hydrology (Theory:04 Credits + Practicals: 02 credits = 06 credits)**BGLD601**2. Elements of Applied Geology & Photogeology (Theory:04 Credits + Practicals: 02 credits = 06 credits)**SKILL ENHANCEMENT COURSE (SEC)****(One each in 3rd, 4th, 5th and 6th semester, if opted from geology)****BGLS302**1. Geomorphology and Geotectonics (04 credits)**BGLS602**2. Photo Geology and Remote Sensing (04 credits)**ABILITY ENHANCEMENT COMPULSORY COURSES (AECC)****(1<sup>st</sup> and 2<sup>nd</sup> semester)****AECC102**1. Environment Science (0 4Credits)**AECC202**2. English or Modern Indian Language communication (04credit)**Total credits (Summary)**Core courses (Th. +Pr.)  $6 \times 4 = 24 \times 03$  (Three Subjects in BSc) = 72DSE (Th. +Pr.)  $6 \times 2 = 12 \times 03$  (Three Subjects in BSc) = 36AECC  $4 \times 2 = 08$  (Common in all the three subjects) = 08SEC  $4 \times 4 = 16$  (one courses each from 03 subjects + one course from any of the 03 subjects) = 16**Total 132 credits to be earned in BSc**

First semesterBGLC101 - Physical Geology and Structural GeologyPhysical geology

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

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

**Unit-III:** Processes of weathering and erosion: factors, types and their effects, elementary idea of geomorphic processes.

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

Structural Geology

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

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

**Unit-III:** Faults: parts of a fault, geometrical and genetic classifications, normal, thrust and slip faults;

**Unit-IV:** definition, kinds and significance of joints and unconformity and salt dome.

BGLL101- Practical• **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.

• **Laboratory record:**• **Viva Voce:****Books Recommended:**

1. Mahapatra, G.B., 1994. A text book of Physical geology. CBS Publishers.
2. Savindra Singh, physical geography, pravalika pub. Allahabad.
3. Billings, M.P., 1972. Structural Geology. Prentice Hall.
4. Davis, G.R., 1984. Structural Geology of Rocks and Region. John Wiley
5. Hills, E.S., 1963. Elements of Structural Geology. Farrod and Sons, London.
6. Singh, R.P., 1995. Structural Geology, A Practical Approach. Ganga Kaveri Publ, Varanasi.
7. Jain A.K., advanced Structural analysis, nem chand and bros.

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Second semesterBGLC201- Mineralogy and CrystallographyMineralogy

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

**Unit-II:** Classification of silicate structures, physical properties of non silicate.

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

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

Crystallography

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

**Unit-II:** Crystal parameters, Weiss and Miller system of notations.

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

**Unit-IV:** Twinning: Laws and Types.

BGLL201- Practical• **Mineralogy:**

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

• **Crystallography:**

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

• **Laboratory record:**• **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.

• **Viva voce:****Books Recommended:**

1. Dana, E.S. and Ford, W.E., 2002. A textbook of Mineralogy (Reprints).
2. Berry, L.G., Mason, B. and Dietrich, R.V., 1982. Mineralogy. CBS Publ.
3. Nesse, D.W., 1986. Optical Mineralogy. McGraw Hill.
4. Read, H.H., 1968. Rutley's Element of Mineralogy (Rev. Ed.). Thomas Murby and Co.
5. Berry and Mason, 1961. Mineralogy. W.H. Freeman & Co.
6. Kerr, B.F., 1995. Optical Mineralogy 5th Ed. McGraw Hill, New York.

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Third semesterBGLC301- PetrologyIgneous Petrology

**Unit-I:** introduction to petrology, Magma: definition, composition and constitution, types and origin; Forms of igneous rocks;

**Unit-II:** Differentiation and Assimilation; Crystallization of uni-component and bi-component (mix-crystals); Bowen's reaction principle.

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

**Unit-IV:** Detailed petrographic description of Granite, Granodiorite, Basalt, Rhyolite, Syenite, Phonolite, Diorite, Gabbro and their volcanic equivalent.

Sedimentary Petrology & Metamorphic Petrology

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

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

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

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

BGLL301- Practical• **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.

• **Laboratory record:**• **Viva Voce****Books Recommended:**

1. Turner, F.J. & Verhoogen, J., 1960, Igneous & Metamorphic petrology. McGrawHill Co.
2. Bose, M.K., 1997. Igneous petrology. World press
3. Tyrell, G.W., 1989. Principles of Petrology. Methuen and Co (Studentsed.)
4. Ehlers, W.G. and Blatt, H., 1987. Petrology, Igneous, Sedimentary and Metamorphic rocks, CBS Publishers
5. Moorhouse, W.W., 1969. The study of rocks in thin sections. Harper and sons.
6. Friedman & Sanders, 1978. Principles of Sedimentology. John Wiley and sons.
7. Pettijohn, F.J., 1975. Sedimentary rocks, Harper & Bros. 3rd Ed.
8. Prasad, C., 1980. A text book of sedimentology.
9. Sengupta, S., 1997. Introduction to sedimentology. Oxford-IBH.
10. Turner, F.J., 1980. Metamorphic petrology. McGrawHill.
11. Mason, R., 1978. Petrology of Metamorphic Rocks. CBS Publ.
12. Winkler, H.G.C., 1967. Petrogenesis of Metamorphic Rocks. Narosa Publ

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Fourth semesterBGLC401- Stratigraphy and PaleontologyStratigraphy

**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.

Paleontology

**Unit-I:** Paleontology: definition, Fossils: definition, characters, mode of preservation, condition of fossilization and significance of fossils, introduction of microfossils (foraminifera, radiolarian, conodont)

**Unit-II:** Morphology and geological distribution of phylum Mollusca and Brachiopod, gastropoda.

**Unit-III:** General morphology and geological history of Phylum Cephalopod and Arthropodation of trilobite.

**Unit-IV:** Evolutionary history of horse, elephant, man; Morphology, distribution and significance of Gondwana flora.

BGLL401 Practical

- Morphological characters, systematic position and age of fossil genera pertaining to brachiopods, pelecypods, cephalopods, trilobite and Echinacea.
- Preparation of lithostratigraphic maps of India showing distribution of important geological formations.
- One day field work in Himalayan terrain from stratigraphic point of view.

Books Recommended:

1. Wadia, D., 1973. Geology of India. McGraw Hill Book co.
2. Krishnan, M.S., 1982. Geology of India and Burma, 6th Edition. CBS Publ.
3. Ravindra Kumar, 1985. Fundamentals of Historical Geology & Stratigraphy of India. Wiley Eastern.
4. Shrock, R.R. & Twenhoffel, W.H., 1952. Principles of Invertebrate Paleontology. CBS Publ.
5. Swinerton, H.H., 1961. Outlines of Paleontology. Edward Arnold Publishers
6. Jain, P.C. & Anantharaman, M.S., 1983. Paleontology: Evolution & Animal Distribution. Vishal Publ.
7. Lehmann, U., 1983. Fossil Invertebrate. Cambridge Univ. Press.
8. Rastogi, 1988. Organic evolution. Kedrath and Ramnath Publ.



Fifth SemesterBGLD501 - Economic Geology and HydrologyEconomic Geology

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

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

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

**Unit-IV:** Distribution of coal and petroleum in India, gas hydrate, coal bed methane.

Hydrology

**Unit-I:** Definition of hydrogeology, Hydrological cycle; Water bearing properties of rocks.

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

**Unit-III:** Origin of groundwater; Vertical distribution of ground water; Types of aquifers;

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

BGLL501 - Practical

- **Economic Geology:** Study of ore and economic minerals in hand specimen; Preparation of maps showing distribution of important metallic and non-metallic deposits and important coal and oil fields of India.
- **Hydrology:** Study of hydrogeological models, Estimation of porosity and permeability from the given data; Preparation and interpretation of water table maps.
- **Laboratory record:**
- **Viva Voce:**

Books Recommended:

1. Brown, C. and Dey, A.K. 1955. Indian Mineral Wealth. Oxford Univ.
2. Gokhale, K.V.G.K. and Rao, T.C., 1983. Ore Deposits of India. East West Press Pvt. Ltd.
3. Jense, M.L. and Bateman A.M., 1981. Economic Mineral Deposits. John Wiley and Sons.
4. Krishnaswamy, S., 1979. India's Minerals Resources. Oxford and IBH Publ.
5. Deb, S., 1980. Industrial minerals and Rocks of India. Allied Publishers Pvt. Ltd.
6. Umeshwar Prasad, 2003. Economic Geology. CBS Publishers and distributors.
7. Sharma, N.L. and Ram, K.V.S., 1972. Introduction to India's Economic Minerals, Dhanbad.
8. Karanth, K. R., 1989. Hydrogeology. Tata McGraw Hill Publ.
9. Raghunath, H.M., 1990. Groundwater. Wiley Eastern Ltd.
10. Subramaniam, V., 2000. Water-Kingston Publ. London.
11. Todd, D.K., ground water hydrology, wiley pub.

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Sixth Semester

BGLD601- Applied Geology and Geomorphology and Photo Geology

Elements of Applied Geology

Unit-I: Engineering properties of rocks and Soils.

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

Unit-III: Tunnels: geology, structure, seepage problem and role of water table, geological investigation of road and bridge.

Unit-IV: Landslides: classification, causes and preventative measures, land slide in Uttarakhand.

Geomorphology and Photo Geology

Unit-I: Basic principles of Geomorphology, geomorphological cycles, weathering and erosion.

Unit-II: Epigene/exogenic processes: degradation and aggradation. Diastrophism and volcanism, Geological work of wind, glacier, river, underground water and ocean, geomorphology of Uttarakhand.

Unit-III: Elementary idea about photo geology: electro-magnetic spectrum, types & geometry of aerial photo graphs; factors affecting aerial photography; types of camera, film and filters.

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

BGLL601 Practical

- Surveying by Plane Table. Preparation of engineering geological maps; Engineering properties and identification of building stones. Identification of various models of landslide, tunnel and dam. Grain size analysis of soil and sediments.

• Laboratory record:

• Viva Voce

- One day visit any dam site of Uttarakhand.

Books Recommended:

1. Krynine D.P. and Judd W.R., 1957. Principles of Engineering Geology & Geotechnics. McGraw-Hill Book
2. Kesavulu, N.C., 2009. A text book of engineering geology. Macmillan Publishing India Ltd.
3. Crozier, M.J., 1989. Landslides: causes, consequences and environment. Academic Press.
4. Bell, F.G., 1983. Fundamentals of Engineering Geology. Butterworth and Co
5. Allen, P., 1997. Earth Surface Processes. Blackwell
6. Bloom, A.L., 1998. Geomorphology: A systematic Analysis of Late Cenozoic Landforms (3rd Edition).
7. Lilleasand, T.M. and Kiffer, R.W., 1987. Remote Sensing and Image Interpretation. John Wiley.
8. Pandey, S.N., 1987. Principles and Application of Photogeology. Wiley Eastern, New Delhi.
9. Sabbins, F.F., 1985. Remote Sensing – Principles and Applications. Freeman.

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**SKILL ENHANCEMENT COURSE****BGL S302****Photo Geology and Remote Sensing**

**Unit-I:** 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;

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

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

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

**Books Recommended:**

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

**BGLS602****Geomorphology and Geotectonics**

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

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

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

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

**Books Recommended:**

1. Allen, P., 1997. Earth Surface Processes. Blackwell
2. Bloom, A.L., 1998. Geomorphology: A systematic Analysis of Late Cenozoic Landforms (3rd Edition).
3. Keary, P. and Vine, F.J., 1997. Global Tectonics. Blackwell and crustal evolution. Butterworth-Heinemann.
4. Kale, V.S. and Gupta, A., 2001. Introduction to Geomorphology. Orient Longman Ltd.
5. Moores, E. and Twiss, R.J., 1995. Tectonics. Freeman.
6. Patwardhan, A. M., 1999. The Dynamic Earth System. Prentice Hall.
7. Summerfield, M.A., 2000. Geomorphology and Global tectonic. Springer Verlag.
8. Valdia, K.S., 1988. Dynamic Himalaya. Universities Press, Hyderabad.
9. WD Thornbury, 2002. Principles of Geomorphology. CBS Publ. New Delhi

*Handwritten signatures and initials in blue ink.*