

## Sri Dev Suman Uttarakhand University, Badshshithaul, Tehri Garhwal

### Proposed Syllabus: GEOLOGY Course for B.Sc (Annual System)

#### Objective of the course

To teach the fundamental concepts of Geology and their applications, the syllabus pertaining to B.Sc (3 year degree course) in the subject of Geology has been prepared as per provision of UGC module and demand of the academic environment. The syllabus concepts are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills. This B. Sc course of Geology consists of three year course (annual system). Total marks: 600(200 per year).

#### **B.Sc. Geology Syllabus**

##### **B.Sc. I year**

S.No.	Title Of The Courses	Maximum Marks
1.	Physical Geology	50
2.	Structural Geology	50
3.	Crystallography And Mineralogy	50
4.	Practical	50
	<b>Total</b>	<b>200</b>

##### **B.sc. II year**

S.No.	Title Of The Courses	Maximum Marks
1.	Petrology	50
2.	Paleontology	50
3.	Stratigraphy	50
4.	Practical	50
	<b>Total</b>	<b>200</b>

##### **B.sc. III year**

S.No.	Title Of The Courses	Maximum Marks
1.	Mineral distribution and ore genesis	50
2.	Elements of applied geology	50
3.	Environmental geology and Geology of Uttarakhand	50
4.	Practical	50
	<b>Total</b>	<b>200</b>

## **B.Sc. I year**

### **Paper I: Physical Geology**

**M. M. 50**

**Unit-I:** Introduction to geology and its branches, their relationship, aims and scope.

**Unit-II** Earth and solar system: origin, size, shape, mass, density and its atmosphere; A brief account of various theories regarding the origin and age of the earth; Brief idea of interior of earth and its composition.

**Unit-III:** External processes-Weathering and Erosion: factors, types and their effects; Geological action of wind, glacier, river, underground water and ocean.

**Unit-IV:** Continents and Oceans, Geosynclines and Mountains.

**Unit-V:** Earthquakes: nature of seismic waves, their intensity and magnitude scale; Origin of earthquake; Volcanoes: types, products and causes of volcanism; Isostasy, Island arcs.

### **Paper II: Structural Geology**

**M. M. 50**

**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 their uses.

**Unit-II:** Elementary idea of types of deformation; Folds: nomenclature and classification; Recognition of fold on maps and in the field.

**Unit-III:** Faults: nomenclature, geometrical and genetic classifications, normal, thrust and slip faults; Recognition of fault on maps and in the field.

**Unit-IV:** Definition, kinds and recognition of joints and unconformity. Brief idea of secondary planar and linear structures.

### **Paper III: Crystallography and Mineralogy**

**M. M. 50**

#### **(A) Crystallography**

**Unit-I:** Crystals and their characters: Crystal form, face, edge, solid angle; Interfacial angle; Crystal parameters, Weiss and Miller system of notations;

**Unit-II:** Symmetry elements and description of normal class of Isometric, Tetragonal, Hexagonal, Trigonal, Orthorhombic, Monoclinic and Triclinic systems; Twinning: laws and types.

**Unit-III:** Crystal studies of the following: (system, type, axes and forms present) Galena, Fluorspar, Leucite, Magnetite, Garnet, Pyrite, Zircon Cassiterite, Vesuvianite, Beryl, Calcite, Baryte, Gypsum, Orthoclase, Hornblende, Axinite.

**Unit-IV:** Minerals: Definition and classification, Silicate structure.

**Unit-V:** Common physical properties of Garnet, Chlorite, Epidote, Calcite, Fluorite, Gypsum, Baryte, Beryl, Tourmaline, Kyanite, Corundum, Orthoclase, Muscovite, Biotite, Quartz, Plagioclase, Hornblende, Pyroxene, Olivine.

**Unit-VI:** Polarizing microscope and its functioning; Ordinary and polarized lights; Optical properties of some common rock forming minerals (Quartz, Orthoclase, Microcline, Olivine, Augite, Hornblende, Muscovite, Biotite, Garnet, Calcite, Sillimanite).

### **Practical**

**M. M. 50**

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| 1. Geological maps and structural problems | 10 |
| 2. Minerals in Hand Specimen               | 10 |
| 3. Crystal Models                          | 05 |
| 4. Physiographic and structural Models     | 05 |
| 5. Geological Field Training               | 10 |
| 6. Sessional and Viva-voce                 | 10 |

**(Geological Field Training:** Students will be required to carry out minimum 03 days field work in a suitable geological area of Himalaya to study the elementary aspects of field geology and submit a report thereon)

**Books Recommended:**

1. Arthur Holmes, 1992. Principles of Physical Geology. Chapman and Hall, London.
2. Miller, 1949. An Introduction to Physical Geology. East West Press Ltd.
3. Spencer, E.V., 1962. Basic concepts of Physical Geology. Oxford & IBH.
4. Mahapatra, G.B., 1994. A text book of Physical geology. CBS Publishers.
5. Billings, M.P., 1972. Structural Geology. Prentice Hall.
6. Davis, G.R., 1984. Structural Geology of Rocks and Region. John Wiley
7. Hills, E.S., 1963. Elements of Structural Geology. Farrold and Sons, London.
8. Singh, R. P., 1995. Structural Geology, A Practical Approach. Ganga Kaveri Publ., Varanasi.
9. Dana, E.S. and Ford, W.E., 2002. A textbook of Mineralogy (Reprints).
10. Flint, Y., 1975. Essential of crystallography, Mir Publishers.
11. Phillips, F.C., 1963. An introduction to crystallography. Wiley, New York.
12. Berry, L.G., Mason, B. and Dietrich, R.V., 1982. Mineralogy. CBS Publ.
13. Nesse, D.W., 1986. Optical Mineralogy. McGraw Hill.
14. Read, H.H., 1968. Rutley's Element of Mineralogy (Rev. Ed.). Thomas Murby and Co.
15. Berry and Mason, 1961. Mineralogy. W.H. Freeman & Co.
16. Kerr, B.F., 1995. Optical Mineralogy 5th Ed. Mc Graw Hill, New York.

## **B. Sc. II year**

### **Paper IV: Petrology**

**M.M. 50**

#### **(A) Igneous Petrology**

**Unit-I:** Magma: definition, composition, types and origin; Forms of igneous rocks; textures and structure of igneous rocks. Reaction Principle; Differentiation and Assimilation.

**Unit-II:** Crystallization of unicomponent and bicomponent (mix-crystals); Bowen's reaction series; Mineralogical and chemical classification of igneous rocks.

**Unit-III:** Detailed petrographic description of Granite, Granodiorite, Rhyolite, Syenite, Phonolite, Diorite, Gabbro, Peridotite, Charnockite, Basalt, Pthichstone, Obsedian.

#### **(B) Sedimentary Petrology**

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

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

#### **(C) Metamorphic Petrology**

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

**Unit-VII:** Petrographic details of some important metamorphic rocks such as - slate, schists, gneiss, quartzite, marble, granulite, migmatite.

### **Paper V: Paleontology**

**M.M. 50**

**Unit-I:** Fossils, Modes of preservation, nomenclature and uses.

**Unit-II:** Brief idea of various Eco-systems, Origin and evolution of Life.

**Unit-III:** Morphology and geological distribution of following groups: Lamellibranchs, Gastropods, Cephalopods, Brachiopods, Trilobites, Echinoids.

**Unit-IV:** Elementary ideas about foraminifera and corals. Evolutionary history of - Dinosaur, Horse, Elephants and Man; Important Gondwana Plant fossils.

**Unit-V:** Study of following genera: Glycemeris, Pecten, Ostrea, Gryphaea, Trigonina, Cardita, Arca, Exogyra, Trocus, turritella, Cypraea, Conus, Cerithium, Murex, Physa, Nautilus, Ceraite, Perisphinctes, Acanthoceras, Belemnites, Pynchonella, Terebratula, Productus, Spirifer, Zaphrentis, Calceola, Hemiaster, Micraster, Glypeaster, Cidaris, Paradoxides, Calymene, Glossopteris, Gangamopteris, Vertebratia, Ptylophyllum.

### **Paper VI: Stratigraphy**

**M.M. 50**

**Unit-I:** Definition, Principle of stratigraphy; Geological Time Scale and stratigraphic classification.

**Unit-II:** Physiographic Divisions of India, elementary idea of tectonics of Peninsula, Himalaya and Ganga Plains.

**Unit-III:** Study of following Precambrian succession: Dharwar, Cuddapha, Vindhyan and Delhi Supergroups; Brief idea of Palaeozoic succession of northwestern Himalaya; Triassic of Spiti; Mesozoic type seccession of Kutch and Rajasthan; Cretaceous of Tiruchirapalli;

**Unit-IV:** Study of following type localities: Gondwana and Deccan Trap.

**Unit-IV:** Palaeogene-Neogene sequences of northwest Himalaya and Assam.

### **Practical:**

**M.M. 50**

1. Rocks in Hand Specimen
2. Rocks in Thin Section

10  
05

3. Fossils in Hand Specimen	10
4. Stratigraphic Rocks in Hand Specimen	05
5. Geological Field Training	10
6. Sessional and Viva-voce	10

**(Geological Field Training:** Students will be required to carry out minimum 05 days field work in a suitable geological area of Himalaya preferably in a fossiliferous terrain to study the elementary aspects of field geology and submit a report thereon)

**Books Recommended:**

1. Turner, F.J. & Verhoogen, J., 1960, Igneous & Metamorphic petrology. McGraw Hill Co.
2. Bose, M.K., 1997. Igneous petrology. World press
3. Tyrell, G. W., 1989. Principles of Petrology. Methuren and Co (Students ed.).
4. Ehlers, WG, and Blatt, H., 1987. Petrology, Igneous, Sedimentary and Metamorphic rocks, CBS Publishers
5. Moorhouse, WW., 1969. The study of rocks in thin sections. Harper and sons.
6. Friedman & Sanders, 1978. Principles of Sedimentology. John Wiley and sons.
7. Pettijohn, F.J., 1975. Sedimentary rocks, Harper & Bros. 3rd Ed.
8. Prasad, C., 1980. A text book of sedimentology.
9. Sengupta. S., 1997. Introduction to sedimentology. Oxford-IBH.
10. Turner, F.J., 1980. Metamorphic petrology. McGraw Hill.
11. Mason, R., 1978. Petrology of Metamorphic Rocks. CBS Publ.
12. Winkler, H.G.C., 1967. Petrogenesis of Metamorphic Rocks. Narosa Publ.
13. Moorhouse, WW., 1969. The study of rocks in thin sections. Harper and sons.
14. Shrock, R.R. & Twenhoffel, W.H., 1952. Principles of Invertebrate Paleontology. CBS Publ.
15. Swinerton, HH., 1961. Outlines of Paleontology. Edward Arnold Publishers
16. Jain, P.C. & Anantharaman, M.S., 1983. Paleontology: Evolution & Animal Distribution. Vishal Publ.
17. Lehmann, U., 1983. Fossil Invertebrate. Cambridge Univ. Press.
18. Wadia, D., 1973. Geology of India. Mc Graw Hill Book co.
19. Krishnan, M.S., 1982. Geology of India and Burma, 6th Edition. CBS Publ.
20. Ravindra Kumar, 1985. Fundamentals of Historical Geology & Stratigraphy of India. Wiley Eastern.
21. Rastogi, 1988. Organic evolution. Kedrnath and Ramnath Publ.

## **B. Sc. III year**

### **Paper VII: Mineral distribution and Ore Genesis**

**M.M. 50**

**Unit-I:** Economic Geology- Definition and Scope. Concept of ore and ore deposits. Forms, structures and Textures of Ore deposits.

**Unit-II:** Ore Genesis: Processes- Magmatic concentration, Contact metasomatism, Hydrothermal, Residual & Mechanical concentration, Sedimentation, Supergene enrichment, Metamorphism.

**Unit-III:** Distribution of important metallic and non-metallic deposits in India, Ore minerals of Fe, Mn, Cr, Ti, W, Cu, Pb, Zn and Al. Industrial minerals- Kyanite, sillimanite, Magnesite, Talc, Gypsum, Fluorite, Phosphorite, Apatite, Baryte, Corundum, Graphite, Mica, Asbestos, Ochre and Chine Clay.

**Unit-IV:** Origin, mode of occurrence and distribution of coal in India; Origin migration, accumulation and distribution of Hydrocarbons in India.

**Unit-V:** Metallogenetic epochs and Provinces, National Mineral Policy.

### **Paper VIII: Elements of Applied Geology**

**M.M. 50**

**Unit-I:** Engineering properties of rocks, soils, soil groups of India.

**Unit-II:** Dams, Reservoirs and Tunnels, Hill roads and Landslide Hazards.

**Unit-III:** Ground water cycle, Hydrological properties of rocks, springs, Hot springs.

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

**Unit-V:** Geological prospecting for ground water. Hydrological provinces of India.

**Unit-VI:** Surface and subsurface geophysical and geological methods of ground water exploration; Groundwater provinces of India; Ground water quality.

### **Paper-IX: Environmental Geology & Geology of Uttarakhand**

**M.M. 50**

**Unit-I:** Biosphere and Man, Earth materials, concept of change.

**Unit-II:** Geological Hazards- Earthquakes, Volcanism, Landslides, Avalanches, Floods, Draughts, Hazard Mitigation.

**Unit-III:** Energy resources: Non-conventional, watershed management. Land use Planning, wastelands. Management of water resources, land reclamation.

**Unit-IV:** Broad setup of Himalaya; Geographic set up of Himalaya. Geological and tectonic divisions of the Himalaya; Himalaya as an orogenic belt; Characteristics of tectonic mountain; Uttarakhand- boundaries, geography and environment.

**Unit-V:** Geomorphology, stratigraphy, Structure & tectonics of Uttarakhand and origin of the Himalaya.

**Unit-VI:** Environmental geological problems of Uttarakhand, natural hazard in Uttarakhand and their remedial measures, geological resources of Uttarakhand, big dams vs. run off the rivers projects in Uttarakhand. Impact of climate change in Uttarakhand

### **Practical:**

**M.M. 50**

1. Economic Minerals in Hand Specimen 10
2. Distribution of Minerals 05
3. Environmental maps/ Hydrological problem 05
4. Plotting of important geological formations/ structural features in the map of Uttarakhand; Identification of important stratigraphic rocks of Uttarakhand in hand specimen. 10
5. Geological Field Training 10

**(Geological Field Training:** Students will be required to carry out minimum 07 days field work in a suitable geological area of Himalaya preferably nearby a river valley project to study the elementary aspects of field geology and submit a report thereon)

**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. Evans, A.M. 1993. Ore Geology and Industrial Minerals. Blackwell ScLPubl.
5. Guilbert, J.M. and Park Jr., C.F. 1986. The Geology of Ore deposits. Freeman & Co.
6. Brown, C. and Dey, A.K. 1955. Indian Mineral Wealth. Oxford Univ.
7. Krishnaswamy, S., 1979. India's Minerals Resources. Oxford and IBH Publ.
8. Deb, S., 1980. Industrial minerals and Rocks of India. Allied Publishers Pvt. Ltd.
9. Umeshwar Prasad, 2003. Economic Geology. CBS Publishers and distributors.
10. Sharma, N.L. and Ram, K.V.S., 1972. Introduction to India's Economic Minerals, Dhanbad.
11. Evans, A.M. 1993. Ore Geology and Industrial Minerals. Blackwell ScLPubl.
12. Valdiya, K.S., 1987. Environmental Geology – Indian Context. Tata McGraw Hill.
13. Parasins, D.S., 1997. Principles of applied geophysics. Chapman Hall.
14. Krynine D.P. and Judd W.R., 1957. Principles of Engineering Geology & Geotechnics. McGraw-Hill Book
15. Kesavulu, N.C., 2009. A text book of engineering geology. Macmillan Publishing India Ltd.
16. Crozier. M.J., 1989. Landslides: causes, consequences and environment. Academic Press.
17. Bell, F.G., 1983. Fundamentals of Engineering Geology. Butterworth and Co.
18. Clark, G.B. 1967. Elements of Mining. 3rd Ed. John Wiley & Sons.
19. Arogyaswami, R.P.N. 1996 Courses in Mining Geology. 4th Ed. Oxford-IBH.
20. Todd. Ground water hydrology
21. Karanth, K. R., 1989. Hydrogeology. Tata McGraw Hill Publ.
22. Raghunath, H. M., 1990. Groundwater. Wiley Eastern Ltd.
23. Subramaniam, V., 2000. Water-Kingston Publ. London.
24. Valdiya, K.S., 1980. Geology of Kumaon Lesser Himalaya.
25. Biyani A.K. 2006. Dimensions of Himalayan. SSPH, Delhi
26. Moon, C.J., Whateley, M.K.G., Evans, A.M., 2006, Introduction to Mineral Exploration, Blackwell Publishing