SYLLABUS FOR B. SC. GEOLOGY (REGULAR)

Six semester course under
Choice Based Credit System (CBCS)

(This is approved in the Academic Council held on 08-11-2019)

Department of Geological Sciences
Gauhati University
2019

OVERALL STRUCTURE

SEMESTER WISE DISTRIBUTION OF COURSES IN B. Sc. NON-HONOURS IN GEOLOGY (CBCS)

Semester	Core Course (12)	AECC (2)	SEC (4)	DSE (6)
I	GLG-RC-1016 * *	ENG-AE-1014		
II	GLG-RC-2016 * *	ENV-AE-2014		
III	GLG-RC-3016 * *		GLG-SE-3014	
IV	GLG-RC-4016 * *		GLG-SE-4014	
V			GLG-SE-5014	GLG-RE-5016 * *
VI			GLG-SE-6014	GLG-RE-6016 * *

*From other disciplines.

CORE COURSE (4) General Structure

Semester	Core Course	Course Name	Credit
I	GLG-RC-1016	General Geology and Structural Geology	6
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	*		
II	GLG-RC-2016	Crystallography and Mineralogy	6
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	*		
III	GLG-RC-3016	Petrology	
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IV	GLG-RC-4016	Stratigraphy and Palaeontology	6
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*From other disciplines.

Skill Enhancement Course (SEC) (4) General Structure

Semester	Paper Structure	Papers available	Credit
III	GLG-SE-3014	Geomorphology and Geo-tectonics	4
IV	GLG-SE-4014	Environmental Geology	4
V	GLG-SE-5014	Geochemistry	4
VI	GLG-SE-6014	Photogeology and Remote Sensing	4

Discipline Specific Elective (DSE) (2) General Structure

Semester	Paper	Papers available for selection	Credit
V	GLG-RE-5016	Economic Geology and Hydrogeology	6
	*		
	*		
VI	GLG-RE-6016	Elements of Applied Geology	6
	*		
	*		

*From other disciplines.

1st SEMESTER

Subject	Sem.	Paper Type	Paper Code	Paper Name	Total Mark	Distribution of mark					Paper Credit (Theory=4, Practical=2)
						End Semester Mark		Internal Mark			
						Theory	Practical	Sessional	Practical	Attendance	
Geology	1st	Regular	GLG-RC-1016	General and Structural Geology	100	60	20	10	6	4	6
		AECC-1	ENG-AE-1014	English Communication	60		---		---		4
		Paper II: To be chosen from other allied subjects			100	60	20	10	6	4	6
		Paper III: To be chosen from other allied subjects			100	60	20	10	6	4	6
				Total	360						22

2nd SEMESTER

Subject	Sem.	Paper Type	Paper Code	Paper Name	Total Mark	Distribution of mark					Paper Credit (Theory=4, Practical=2)
						End Semester Mark		Internal Mark			
						Theory	Practical	Sessional	Practical	Attendance	
Geology	2nd	Regular	GLG-RC-2016	Crystallography and Mineralogy	100	60	20	10	6	4	6
		AECC-2	ENV-AE-2014	Environment Science	60	60	---	----	---	---	4
		Paper II: To be chosen from other allied subjects			100	60	20	10	6	4	6
		Paper III: To be chosen from other allied subjects			100	60	20	10	6	4	6
Total					360						22

3rd SEMESTER

Subject	Sem.	Paper Type	Paper Code	Paper Name	Total Mark	Distribution of mark					Paper Credit (Theory=4, Practical=2)
						End Semester Mark		Internal Mark			
						Theory	Practical	Sessional	Practical	Attendance	
Geology	3rd	Regular	GLG-RC-3016	Petrology	100	60	20	10	6	4	6
		SEC-1	GLG-SE-3014	Geomorphology and Geo-tectonics	60	48	---	8	---	4	4
		Paper II: To be chosen from other allied subjects			100	60	20	10	6	4	6
		Paper III: To be chosen from other allied subjects			100	60	20	10	6	4	6
				Total	360						22

4th SEMESTER

Subject	Sem.	Paper Type	Paper Code	Paper Name	Total Mark	Distribution of mark					Paper Credit (Theory=4, Practical=2)
						End Semester Mark		Internal Mark			
						Theory	Practical	Sessional	Practical	Attendance	
Geology	4th	Regular	GLG-RC-4016	Stratigraphy and Palaeontology	100	60	20	10	6	4	6
		SEC-2	GLG-SE-4014	Environmental Geology	60	48	---	8	---	4	4
		Paper II: To be chosen from other allied subjects			100	60	20	10	6	4	6
		Paper III: To be chosen from other allied subjects			100	60	20	10	6	4	6
				Total	360						22

5th SEMESTER

Subject	Sem.	Paper Type	Paper Code	Paper Name	Total Mark	Distribution of mark					Paper Credit (Theory=4, Practical=2)
						End Semester Mark		Internal Mark			
						Theory	Practical	Sessional	Practical	Attendance	
Geology	5th	DSE- 1	GLG-RE-5016	Economic Geology and Hydrogeology	100	60	20	10	6	4	6
		SEC-3	GLG-SE-5014	Geochemistry	60	48	---	8	---	4	4
		Paper II: To be chosen from other allied subjects			100	60	20	10	6	4	6
		Paper III: To be chosen from other allied subjects			100	60	20	10	6	4	6
				Total	360						22

6th SEMESTER

Subject	Sem.	Paper Type	Paper Code	Paper Name	Total Mark	Distribution of mark					Paper Credit (Theory=4, Practical=2)
						End Semester Mark		Internal Mark			
						Theory	Practical	Sessional	Practical	Attendance	
Geology	6th	DSE- 2	GLG-RE-6016	Elements of Applied Geology	100	60	20	10	6	4	6
		SEC-4	GLG-SE-6014	Photogeology and Remote Sensing	60	48	---	8	---	4	4
		Paper II: To be chosen from other allied subjects			100	60	20	10	6	4	6
		Paper III: To be chosen from other allied subjects			100	60	20	10	6	4	6
				Total	360						22

1st SEMESTER

Core course

Paper Code: GLG-RC-1016

Paper Name: GENERAL GEOLOGY AND STRUCTURAL GEOLOGY

Credits: 6 (THEORY - 4, RACTICALS - 2)

Paper Code	Paper Name	Total Mark	Distribution of mark					Paper Credit (Theory=4, Practical=2)
			End Semester Mark		Internal Mark			
			Theory	Practical	Sessional	Practical	Attendance	
GLG-RC 1016	General Geology and Structural Geology	100	60	20	10	6	4	6

THEORY **Marks = 60**

Unit-1: General Geology 30

- Introduction to geology, its scope and its subdivisions and relation to other branches of science.
- Earth and Solar System: Origin, size, shape, mass, density and age of the earth. Major surface features of the earth: continents and ocean basins and their evolution.
- Introduction to igneous, sedimentary and metamorphic rocks and their distinguishing characters.
- Weathering and Erosion: factors, types and their effects.
- Volcanoes and volcanism; Types and distribution of volcanoes; Earthquake: Causes of earthquake; Earthquake belts; Prediction of earthquake; Earthquake zones of India; Use of seismic waves in the study of earth's internal constitution.

Unit-2: Structural Geology 30

- Definition and scope of Structural Geology; Primary, secondary and penecontemporaneous structures.
- Concept of non-diastrophic and diastrophic structures.Non-diastrophic structures: stratification, current or cross bedding, graded bedding, ripple marks, unconformities, mud cracks and rain prints, flow layers, primary joints, vesicular and amygdaloidal structures and pillow structure.
- Elementary idea of types of deformation, Concept of Stress and Strain, Mohr's stress circle; Elasticity, plasticity and brittleness; Diastrophic structures: Planar

and linear structures; Strike direction, dip angle, dip direction, Basic concepts of Lineation, Foliation, Fold, Fault and Joints: their origin.

PRACTICAL **Marks = 20**

Unit-1: General Geology **10**

- Study of contours: Pattern of contours to indicate various topographical features;
- Reading of topographical maps of the Survey of India; Interpretation of topographic maps; Drawing of profile
- Study of geomorphological features from topographic maps.
- Model study of different geomorphic features.

Unit-2: Structural Geology **10**

- Study of Clinometer and Brunton Compass, Identification of different types of folds/faults from models. Preparation of cross-section profile from geological map.
- Use of Stereographic net (Wulf's net or Schmidt's net) in:
  (i) Plotting of planes.
  (ii) Plotting of poles to the planes.
  (iii) Plotting of lines.
  (iv) Determination of plunge and bearing of the line of intersection between two planes.
  (v) Determination of angle between two planes.
  (vi) Determination of apparent dip/dips in different directions in a plane.
  (vii) Determination of strike and true dip of a plane from apparent dip/dips.

SUGGESTED READINGS:

1. Holmes' *Principles of Physical Geology*. 1992. Chapman & Hall.
2. Patwardhan, A. M., The *Dynamic Earth System*, PHI Learning.
3. Park, R. G. (2004). *Foundations of Structural Geology*. Chapman & Hall.
4. Pollard, D. D. (2005). *Fundamental of Structural Geology*. Cambridge University Press.
5. Ragan, D. M. (2009). *Structural Geology: an introduction to geometrical techniques* (4th Ed). Cambridge University Press (For Practical)
6. Fossan, H. (2010). *Structural Geology*, Cambridge University Press.
7. Bloom A.L., (1998). *Geomorphology: A Systematic Analysis of Late Cenozoic Landforms.* Pearson Education.

2nd SEMESTER

Core Courses
Paper Code: GLG-RC-2016
Paper Name: CRYSTALLOGRAPHY AND MINERALOGY
Credits: 6 (THEORY - 4, PRACTICALS - 2)

Paper Code	Paper Name	Total Mark	Distribution of mark					Paper Credit (Theory=4, Practical=2)
			End Semester Mark		Internal Mark			
			Theory	Practical	Sessional	Practical	Attendance	
GLG-RC 2016	Crystallography and Mineralogy	100	60	20	10	6	4	6

THEORY **Marks = 60**

Unit-1: Crystallography 20

- Definition of crystal and amorphous substance; Crystallization and crystal growth; Unit cell; Symmetry operations and elements; Crystallographic axes and angles, Axial ratio; Crystal forms and habit;Face, Interfacial angle, solid angle, Parameters and indices.
- Study of the Normal class of Isometric, Tetragonal, Hexagonal, Orthorhombic, Monoclinic and Triclinic systems.

Unit-2: Mineralogy 20

- Scope of Mineralogy; Definition of mineral; Physical properties of mineral, Mineral classification.
- Study of chemical composition and diagnostic physical properties of the following minerals: Quartz, Orthoclase, Microcline, Hypersthene, Hornblende, Garnet, Muscovite, Biotite, Enstatite, Olivine, Kyanite, Sillimanite, Calcite, Plagioclase.

Unit-3: Optical Mineralogy 20

- Nature of light; Reflection and refraction of rays; Refractive index, Polarization of light; Polarising Microscope, Double refraction by Nicol prism, Pleochroism.
- Cleavage, Extinction, Interference colour, Accessory plates (Mica Plate, Gypsum Plate and Quartz Wedge) and their uses.
- Isotropic and Anisotropic minerals: Uniaxial and Biaxial; Optic axis; Interference figure, Optic sign.
- Study of optical properties of the following minerals: Quartz, Orthoclase,

Microcline, Hypersthene, Hornblende, Garnet, Muscovite, Biotite, Enstatite, Olivine, Kyanite, Sillimanite, Calcite, Plagioclase.

PRACTICAL **Marks = 20**

Unit-1: Crystallography **7**

- Study of the forms and symmetry elements of crystals belonging to the holohedral classes of Isometric, Tetragonal, Hexagonal, Orthorhombic, Monoclinic and Triclinic systems with the help of either natural crystals or wooden and glass models;
- Drawing of crystals in clinographic projections.

Unit-2: Physical Mineralogy **6**

- Identification of following minerals in hand specimen: Quartz, Orthoclase, Microcline, Hypersthene, Hornblende, Garnet, Muscovite, Biotite, Enstatite, Olivine, Kyanite, Sillimanite, Calcite, Plagioclase.

Unit-3: Optical Mineralogy **7**

- Study of optical properties of the following minerals in thin section: Quartz, Orthoclase, Microcline, Hypersthene, Hornblende, Garnet, Muscovite, Biotite, Enstatite, Olivine, Kyanite, Sillimanite, Calcite, Plagioclase.

SUGGESTED READINGS:

1. Cornelis Klein and Anthony Philpotts (2013), *Earth Materials- Introduction to Mineralogy and Petrology*, Cambridge University Press
2. Klein, C., Dutrow, B., Dwight, J., & Klein, C. (2007). The 23rd Edition of the Manual of Mineral Science (after James D. Dana). J. Wiley & Sons.
3. Kerr, P. F. (1959). Optical Mineralogy. Mc Graw-Hill.
4. Verma, P. K. (2010). Optical Mineralogy (Four Colour). Ane Books Pvt Ltd.
5. Deer, W. A., Howie, R. A., & Zussman, J. (1992). An introduction to the rock-forming minerals (Vol. 696). London: Longman.
6. Mineralogy: Perkins and Henke
7. J.D. Dana. Textbook of Mineralogy
8. C. Klein and C.S. Hurlbut, Jr (1985). Manual of Mineralogy. Jhon Wiley & Sons, New York

3rd SEMESTER

Core Courses

Paper Code: GLG-RC-3016

Paper Name: PETROLOGY

Credits: 6 (THEORY - 4, PRACTICALS - 2)

Paper Code	Paper Name	Total Mark	Distribution of mark					Paper Credit (Theory=4, Practical=2)
			End Semester Mark		Internal Mark			
			Theory	Practical	Sessional	Practical	Attendance	
GLG-RC-3016	Petrology	100	60	20	10	6	4	6

THEORY **Marks = 60**

Unit-1: Igneous Petrology **20**

- Magma: Composition, origin and types; Crystallisation of Magma, Bowen's reaction; Magmatic differentiation; Assimilation.
- Igneous rocks: Definition; Mode of occurrence; Textures and structures; Classification of igneous rocks on textural, mineralogical and chemical criteria.
- Petrography of Granite, Dolerite, Gabbro, Rhyolite, Syenite, Basalt and Diorite.

Unit-2: Sedimentary Petrology **20**

- Introduction; Processes of formation of sedimentary rocks–weathering, transportation, deposition, diagenesis.
- Textures and structures of sedimentary rocks; Sedimentary structures: lamination, ripple marks, current bedding, graded bedding, mud cracks, rain prints.
- Classification of sedimentary rocks; Petrographic description of: sandstone, siltstone, shale, limestone, breccia and conglomerate.

Unit-3: Metamorphic Petrology **20**

- Metamorphic rocks: Definition; Factors or Agents of Metamorphism; Types of Metamorphism; Grade of Metamorphism, Zones of Metamorphism; Textures and Structures of Metamorphic rocks.
- Descriptive petrography of Slate, Phyllite, Schist, Gneiss, Quartzite and Marble.

PRACTICAL **Marks = 20**

Unit-1: Igneous Petrology **5**

- Hand specimen study of the following rocks: Granite, granodiorite, gabbro, diorite, pegmatite, rhyolite, dolerite, basalt.
- Study and identification of following rocks in thin sections under petrological microscope: Granite, Dolerite, Gabbro, Rhyolite, Syenite and Diorite.

Unit-2: Sedimentary Petrology **5**

- Hand specimen study of the following rocks: Conglomerate, Sandstone, Shale, Fossiliferous limestone.
- Study and identification of following rocks in thin sections under petrological microscope: Sandstone, Shale, Limestone, Conglomerate.

Unit-3: Metamorphic Petrology **5**

- Hand specimen study of the following rocks: Slate, phyllite, schists, gneiss, marble, quartzite, mylonite, migmatite and Amphibolite.
- Study and identification of following rocks in thin sections under petrological microscope: Chlorite schist, Biotite schist, Sillimanite schist, Amphibolite/ Hornblende schist, Quartzite, Granulite, Granite Gneiss.

Unit-4: Field Training and Viva Voce **5**

- Students will be required to carry out 03 days field work in a suitable geological area to study the elementary aspects of field geology and submit a report there on.

SUGGESTED READINGS:

1. Winter, J. D. (2014). *Principles of igneous and metamorphic petrology*. Pearson.
2. Raymond, L. A. (2002). *Petrology: the study of igneous, sedimentary, and metamorphic rocks*. McGraw-Hill Science Engineering.
3. Myron G. Best (2001). *Igneous and Metamorphic Petrology*,
4. Bose M.K. (1997). *Igneous Petrology*.
5. Tucker, M. E. (2006). Sedimenary Petrology, Blackwell Publishing.
6. Collinson, J. D. & Thompson, D. B. (1988). *Sedimentary structures*, Unwin- Hyman, London
7. Sengupta S., *Introduction to Sedimentology*, Oxford & IBH Publishing Co.
8. Sam Boggs, Jr. (2009). *Petrology of Sedimentary Rocks*, Cambridge Univ. Press
9. Yardley, B.W., & Yardley, B.W.D. (1989). An *introduction to metamorphic petrology*. Longman Earth Science Series.

Skill Enhancement Course (SEC-1)

Paper Code: GLG-SE-3014

Paper Name: GEOMORPHOLOGY AND GEO-TECTONICS

Credits:4

Paper Type	Paper Code	Paper Name	Total Mark	Distribution of mark					Paper Credit
				End Semester Mark		Internal Mark			
				Theory	Practical	Sessional	Practical	Attendance	
SEC-1	GLG-SE-3014	Geomorphology and Geo-tectonics	**60**	**48**	**---**	**8**	**---**	**4**	**4**

THEORY **Marks = 48**

Unit-1: Geomorphology **24**

- Basic principles of geomorphology, Geomorphological cycle, weathering and erosion, Geomorphic mapping- tools and techniques.

- Epigenic and exogenic processes, degradation and aggradation, hypogenic and endogenic processes, diastrophism and volcanism, Geological work of wind, glacier, river, groundwater and ocean.

Unit-2: Geo-tectonics **24**

- Earth as a dynamic system, Elementary idea of Continental Drift, Sea-floor spreading and mid-oceanic ridges. Palaeomagnetism and its application.
- Plate Tectonics: the concept, plate margins, orogeny, deep sea trenches, island arcs and volcanic arcs.

SUGGESTED READINGS:

1. Bloom A.L., (1998). *Geomorphology: A Systematic Analysis of Late Cenozoic Landforms,* Pearson Education.
2. Esterbrook D.J., (1992). *Surface Processes and Landforms,* MacMillan Publ.
3. Kale, V.S. and Gupta A. (2001). *Intoduction to Geomorphology,* Orient Longman Ltd.
4. Holmes' *Principles of Physical Geology*. 1992. Chapman & Hall.
5. Patwardhan, A. M., The *Dynamic Earth System*, PHI Learning.

4th SEMESTER

Core Courses

Paper Code: GLG-RC-4016

Paper Name: STRATIGRAPHY AND PALAEONTOLOGY

Credits: 6 (THEORY - 4, PRACTICALS - 2)

Paper Type	Paper Code	Paper Name	Total Mark	Distribution of mark					Paper Credit (Theory=4, Practical=2)
				End Semester Mark		Internal Mark			
				Theory	Practical	Sessional	Practical	Attendance	
Regular	GLG-RC-4016	Stratigraphy and Palaeontology	**100**	**60**	**20**	**10**	**6**	**4**	**6**

THEORY **Marks = 60**

Unit-1: Principles of Stratigraphy 15

- Definition and Scope, Principles of Stratigraphy: Superposition of strata; Neptunism, Uniformitarianism; Catastrophism, Smith and Applied Stratigraphy; Lyell's Principles of Geology.
- Standard Geological time scale; Stratigraphic classification – concepts of Time (Chronological), Time-Rock (Chronostratigraphic), Rock (Lithostratigraphic) and Bio-stratigraphic units.Concept of sedimentary facies; Principles of Stratigraphic Correlation.

Unit-2: Indian Stratigraphy 25

- A brief study of the Precambrian stratigraphy of India of the following areas with respect to lithology, tectonics and igneous activity:
  a) Dharwar Province (Karnataka)
  b) Assam-Meghalaya plateau (Shillong plateau)
  c) Delhi Super Group
  d) Cuddapah Super Group of Cuddapah basin
  e) Vindhyan Super Group of Sone Valley.
- Phanerozoic Succession of India:
  a) Triassic of Spiti
  b) Jurassic of Kutch
  c) Cretaceous of Trichinopoly
  d) Gondwana Super Group
  e) Cenozoic stratigraphy of NE India
  f) Deccan Traps
  g) Paleogene-Neogene sequence of NW Himalaya and Assam

Unit-3: Palaeontology **20**

- Palaeontology: definition and kinds of fossils; Mode of preservation of fossils. Broad divisions of invertebrates into different phyla (binomial nomenclature and taxonomy) and their major characteristics. Significance of fossils.
- A study of the morphological characters and brief geological distribution of the following phyla/classes - Brachiopoda, Lamellibranchia, Cephalopoda, Trilobita and Echinoidea.
- Evolutionary history of Horse.
- A general idea on the plant fossils of Gondwana Flora, its distribution and palaeo- geographic significance.

PRACTICAL **Marks = 20**

Unit-1: Indian Stratigraphy **8**

- Preparation of lithostratigraphic maps of India showing distribution of important geological formations:
- Dharwar Province, Shillong Group of rocks,Cuddapah Super Group, Vindhyan Super Group, Jurassic of Kutch, Cretaceous of Trichinopoly, Gondwana Super Group, Deccan Traps.

Unit-2: Palaeontology **12**

- Identification of the following genera of fossils by their external morphology. Their stratigraphic ranges will also have to be studied:
  a) Cidaris, Hemiaster, Micraster, Echinolampus, Clypeaster, Stygmatopygus
  b) Orthis, Productus, Spirifer, Terebratula, Pentamerus, Rhynchonella, Syringothyris
  c) Arca, Cardita, Exogyra, Glycemeris, Pecten, Plicatula, Ostrea, Trigonia
  d) Baculites, Belemnites, Ceratites, Hamites, Goniatite, Nautilus, Perisphinctes
  e) Calymene, Phacops
  f) Glossopteris, Gangamopteris, Ptillophyllum, Vertebraria

  [In case of non-availability of fossils, representative casts of fossils may be used in the Exercises.]

SUGGESTED READINGS:

1. Schoch, R.M. 1989. Stratigraphy, Principles and Methods.VanNostrand Reinhold.
2. Clarkson, E.N.K.1998. Invertebrate Paleontology and Evolution George AlIen&Unwin
3. Benton, M.J. 2005. Vertebrate paleontology (3rd edition). Blackwell Scientific, Oxford.
4. Colbert's Evolution of the Vertebrates: A History of the Backboned Animals Through Time, EdwinH. Colbert, Michael Morales, Eli C. Minkoff, John Wiley & Sons, 1991.

5. Dasgupta A. *An introduction to palaeontology*.World Press, Kolkata
6. Krishnan, M. S. (1982). *Geology of India and Burma*, CBS Publishers, Delhi
1. Ramakrishnan, M. &Vaidyanadhan, R. (2008). *Geology of India Volumes 1 & 2*, Geological society of India, Bangalore.
2. Naqvi, S.M. and Rogers, J.J.W. *Precambrian Geology of India*, Oxford University Press.
3. Kumar, R., *Fundamentals of Historical Geology and Stratigraphy of India*, New Age International Publishers.

Skill Enhancement Course (SEC-2)

Paper Code: GLG-SE-4014

Paper Name: Environmental Geology

Credits: 4

Paper Type	Paper Code	Paper Name	Total Mark	Distribution of mark					Paper Credit
				End Semester Mark		Internal Mark			
				Theory	Practical	Sessional	Practical	Attendance	
SEC-2	GLG-SE-4014	Environmental Geology	60	48	---	8	---	4	4

THEORY **Marks = 48**

Unit-1:Environmental Geology 48

- Earth and its spheres: Atmosphere, Hydrosphere, Lithosphere, Biosphere and Man; Earth Material.
- Energy Budget: Solar Radiation; Global environments: Coastal, riverine, desertic, tropical, cold, polar; Concept of global warming and climate change.
- Geological hazards: Earthquakes, Volcanism, Landslides, Avalanches, Floods, Droughts; Hazard mitigation.
- Resource management: Energy resources (conventional and non-conventional), watershed management, land use planning, management of water resources, land reclamation.

SUGGESTED READINGS:

1. E. A. Keller (2010), *Environmental Geology*. Pearson.
2. C.W. Montogomery (2002), *Environmental Geology.*

3. K.S. Valdiya (2013), *Environmental Geology: Ecology, Resource and Hazard Management*. McGraw Hill Education (India) Private Limited, New Delhi.

5th SEMESTER

Discipline Specific Elective (DSE 1)
Paper Code: GLG-RE-5016
Paper Name: Economic Geology and Hydrogeology
Credits: 6 (THEORY - 4, PRACTICALS - 2)

Paper Type	Paper Code	Paper Name	Total Mark	Distribution of mark					Paper Credit (Theory=4, Practical=2)
				End Semester Mark		Internal Mark			
				Theory	Practical	Sessional	Practical	Attendance	
DEC- 1	GLG-RE-5016	Economic Geology and Hydrogeology	100	60	20	10	6	4	6

THEORY **Marks = 60**

Unit-1: Economic Geology and Prospecting 30

- Definition of ore, gangue and tenor; Metallic and non-metallic ore minerals; Strategic, critical and essential minerals.
- Processes of formation of economic mineral deposits: Magmatic, contact metasomatic, hydrothermal, sedimentation processes (with Indian examples).
- Study of mineralogy, mode of occurrence, origin and uses of the following economic mineral deposits with reference to Indian occurrences:

a) Metallic mineral deposits: Aluminium, Copper, Manganese, Iron, Lead, Zinc and Gold.
b) Non-metallic mineral deposits: Limestone, Gypsum, Mica, Magnesite, Sillimanite, Asbestos.

- Origin and occurrence of coal and petroleum in India.

Unit-2: Hydrogeology 30

- Definition, Hydrological parameters: precipitation, evaporation, transpiration, infiltration; Hydrologic cycle, Origin of ground water; Vertical distribution of Ground-water, types of Aquifers.
- Water bearing properties of rocks: Porosity, Permeability, Specific yield, Specific retention.
- Surface and sub-surface geophysical and geological methods of groundwater exploration.

- Groundwater provinces of India.

PRACTICAL **Marks = 20**

Unit-1: Economic Geology **12**

- Recognition of the following economic minerals in hand specimens: Calcite, Dolomite, Graphite, Malachite, Chalcopyrite, Pyrite, Haematite, Magnetite, Pyrolusite, Psilomelane, Sphalerite, Bauxite, Laterite, Asbestos, Gypsum, Galena, Cuprite, Zincite, Gypsum, Coal.
- Preparation of map showing distribution of important metallic (Aluminium, Copper, Manganese, Iron, Lead, Zinc and Gold) and non-metallic (Limestone, Gypsum, Mica, Magnesite, Sillimanite, Asbestos) mineral deposits and important oil and coal fields of India.

Unit-2: Hydrogeology **8**

- Study of hydrogeological models, estimation of porosity and permeability from the given data.
- Preparation and interpretation of water table maps.

SUGGESTED READINGS:

1. Guilbert, J.M. and Park Jr., C.F. (1986). *The Geology of Ore deposits*. Freeman & Co.
2. Bateman, A.M. and Jensen, M.L. (1990). *Economic Mineral Deposits*. John Wiley.
3. Evans, A.M. (1993). *Ore Geology and Industrial minerals.* Wiley
4. Laurence Robb. (2005). *Introduction to ore forming processes*. Wiley.
5. Gokhale, K.V.G.K. and Rao, T.C. (1978). *Ore deposits of India their distribution and processing*, Tata-McGraw Hill, New Delhi.
6. Todd, D. K. (2006). *Groundwater hydrology*, 2nd Ed., John Wiley & Sons, N.Y.
7. Davis, S. N. and De Weist, R.J.M. (1966). *Hydrogeology*, John Wiley & Sons Inc., N.Y.
8. Karanth K.R., (1987). *Groundwater: Assessment, Development and management*, Tata Mc Graw-Hill Pub. Co. Ltd.
9. Mahajan G. (2008). *Evaluation and Development of Groundwater,* APH Publishing Corporation, New Delhi

Skill Enhancement Course (SEC-3)

Paper Code: GLG-SE-5014

Paper Name: GEOCHEMISTRY

Credits: 4

Paper Type	Paper Code	Paper Name	Total Mark	Distribution of mark					Paper Credit
				End Semester Mark		Internal Mark			
				Theory	Practical	Sessional	Practical	Attendance	
SEC-3	GLG-SE-5014	Geochemistry	**60**	**48**	**---**	**8**	**---**	**4**	**4**

THEORY **Marks = 48**

Unit-1: Geochemistry 48

- Introduction to Geochemistry, Basic knowledge about crystal chemistry, types of chemical bonds, co-ordination number, elementary idea of periodic table.
- Cosmic abundance of elements; composition of the planets and meteorites, geochemical evolution of the earth and geochemical cycles.
- Goldschmidt's geochemical classification of elements, distribution of major, minor and trace elements in igneous, metamorphic and sedimentary rocks.
- Elements of geochemical thermodynamics; isomorphism and polymorphism; isotope geology.

SUGGESTED READINGS:

1. Mason, B. and Moore (1986). Principles of Geochemistry. 3rd Edition, Wiley New York.
2. Walther, J. V. (2009). Essentials of geochemistry. Jones & Bartlett Publishers.
3. Albarède, F. (2003). Geochemistry: an introduction. Cambridge University Press.
4. Faure, Gunter and Teresa M. Mensing (2004). Isotopes: Principles and Applications,Wiley India Pvt. Ltd

6th SEMESTER

Discipline Specific Elective (DSE-2)
Paper Code: GLG-RE-6016

Paper Name: ELEMENTS OF APPLIED GEOLOGY
Credits: 6 (THEORY - 4, PRACTICALS - 2)

Paper Type	Paper Code	Paper Name	Total Mark	Distribution of mark					Paper Credit (Theory=4, Practical=2)
				End Semester Mark		Internal Mark			
				Theory	Practical	Sessional	Practical	Attendance	
DEC- 2	GLG-RE-6016	Elements of applied geology	100	60	20	10	6	4	6

THEORY **Marks = 60**

Unit-1: Elements of Applied Geology **60**

- Definition of soil, processes of soil formation, Engineering properties of rocks and soil, Soil types of India.
- Dam: definition and types of dam, geological and environmental considerations of dams, geological problem of reservoirs.
- Tunnels: definition; geological considerations of tunnel, seepage problem and role of water table.
- Landslides: definition and classification of landslides; its causes and mitigation.
- Mineral exploration: Elementary idea of geological, geophysical and geochemical prospecting.
- Concept of Mining, types of mining, impact of mining on environment.

PRACTICAL **Marks = 20**

Unit-1: Elements of Applied Geology **20**

- Surveying by plane table/ prismatic compass/ theodolite.
- Preparation of engineering geological maps, engineering properties and identification of building stones.
- Identification of various types of landslide and dams from given representative models/ figures/ photographs.
- Study of soil profiles.

SUGGESTED READINGS:

1. Krynin, D.P. and Judd W.R. 1957. Principles of Engineering Geology and Geotechnique, McGraw Hill (CBS Publ).
2. Johnson, R.B. and De Graf, J.V. 1988. Principles of Engineering Geology, John Wiley.
3. Goodman, R.E., 1993. Engineering Geology: Rock in Engineering constructions. John Wiley & Sons, N.Y.
4. Waltham, T., 2009. Foundations of Engineering Geology (3rd Edn.) Taylor & Francis.
5. Bell: F.G-, 2006. Basic Environmental and Engineering Geology Whittles Publishing.
6. Bell, .F.G, 2007. *Engineering Geology,* Butterworth-Heineman

Skill Enhancement Course (SEC-4)

Paper Code: GLG-SE-6014

Paper Name: PHOTOGEOLOGY AND REMOTE SENSING

Credits: 4

Paper Type	Paper Code	Paper Name	Total Mark	Distribution of mark					Paper Credit
				End Semester Mark		Internal Mark			
				Theory	Practical	Sessional	Practical	Attendance	
SEC-4	GLG-SE-6014	Photogeology and Remote Sensing	60	48	---	8	---	4	4

THEORY **Marks = 48**

Unit-1: Photogeology **12**

- Elementary idea about photo-geology, aerial photographs and satellite images; types and geometry of aerial photographs; factors effecting aerial photographs; types of camera, film and filters, factors effecting photographic scale.

Unit-**2: Remote Sensing** **36**

- Introduction to Remote Sensing; Electro-magnetic energy and spectrum; atmospheric windows; Energy sources for Remote Sensing; Sensor & platform;
- Signature of rocks, minerals and soils; Application of Remote Sensing in Geo-sciences and geomorphological studies.
- Types of Indian and Foreign Remote Sensing Satellites. Digital image processing; fundamental steps in image processing; elements of pattern recognition and image classification.
- Introduction to GIS, components of GIS, product generation in GIS, tools for map analysis; integration of GIS with remote sensing.

SUGGESTED READINGS:

1. Demers, M.N., 1997. *Fundamentals of Geographic Information System*, John Wiley & sons. Inc.
2. Jensen, J.R., 1996. *Introductory Digital Image Processing: A Remote Sensing Perspective*, Springer- Verlag.
3. Lillesand, T. M. & Kiefer, R.W., 2007. *Remote Sensing and Image Interpretation*, Wiley.
4. Richards, J.A. and Jia, X., 1999. *Remote Sensing Digital Image Analysis*, Springer-Verlag.
5. S.N.Pandey (2001), *Principles and Applications of Photogeology*. New Age International (P) Limited, Publishers