काशी हिन्दू विश्वविद्यालय

BANARAS HINDU UNIVERSITY

B.Sc. (Hons) Geology
Three Years (Six Semester Course)

SYLLABUS
w.e.f. SESSION 2018-19

Centre of Advanced Study
Department of Geology
Institute of Science
Banaras Hindu University
Varanasi 221005

BANARAS HINDU UNIVERSITY
DEPARTMENT OF GEOLOGY

B.Sc. (Hons.) GEOLOGY SYLLABUS, proposed w.e.f. 2018-19

The B.Sc. (Hons.) Geology shall be imparted to students for three academic sessions consisting of six semesters as given below. Candidates will be examined and evaluated on grade basis at the end of each semester in the different courses of theory and practical as per credits given (see table) against each course.

The BSc (Hons) Geology will consist of (a) Core Course and (b) Geological Field Training.

(a) The core course will be compulsory for all the admitted students. There will be seven core courses, each of 5.5 credits (4 credits for theory and 1.5 credit for practical) covering major branches of Geology.
(b) * The compulsory geological field training includes a few days field work. The field training will be conducted by faculty members. Geological field training for semesters I to IV is included in the respective practicals. Compulsory Geological field training (course GLB507) may be undertaken any time during the combined duration of semester (V &VI) inclusive of semester break.

B.Sc. (Hons.) Geology Syllabus
(Effective from 2018-19)

SEMESTER – I		
Course Code	**Title**	**Credits**
GLB101	Elementary Physical and Structural Geology	4
GLB102	Practicals connected with GLB101(inclusive of Geological Field Training*)	2
	Total	**6**
	SEMESTER – II	
GLB201	Elements of Mineralogy and Crystallography	4
GLB202	Practicals connected with GLB201	2
	Total	**6**
	Ancillary –Elements of Geology-I	2
	TOTAL	**8**

SEMESTER – III		
GLB301	Petrology and Economic Geology	4
GLB302	Practicals connected with GLB301(inclusive of Geological Field Training*)	2
	Total	**6**
SEMESTER – IV		
GLB401	Paleontology and Stratigraphy	4
GLB402	Practicals connected with GLB401	2
	Total	**6**
	Ancillary –Elements of Geology-II	2
	TOTAL	**8**
SEMESTER – V		
GLB501	Physical and Structural Geology	4
GLB502	Igneous Petrology, Mineralogy and Crystallography	4
GLB503	Sedimentary and Metamorphic Petrology	4
GLB504	Practicals connected with GLB501	1.5
GLB505	Practicals connected with GLB502	1.5
GLB506	Practicals connected with GLB503	1.5
GLB507	Compulsory Geological Field Training*	4.5
	Total	**21**
SEMESTER – VI		
GLB601	Paleontology	4
GLB602	Stratigraphy	4
GLB603	Hydrogeology, Environmental Geology, Exploration Geology and Computer Application	4
GLB604	Economic Geology	4
GLB605	Practicals connected with GLB601	1.5
GLB606	Practicals connected with GLB602	1.5
GLB607	Practicals connected with GLB604	1.5
GLB608	Assignment	2.5
	Total	**23**
	GRAND TOTAL	**72**

SEMESTER – I

Course No. GLB101: ELEMENTARY PHYSICAL AND STRUCTURAL GEOLOGY Cr.: 4

Section – A: Physical Geology

Unit-1

Introduction to geology, scope, subdisciplines and relationship with other branches of science; Earth in the solar system, origin, size, shape, mass, density, rotational and evolutional parameters. Internal constitution of the earth, core, mantle and crust; Convections in the earth's core and production of magnetic field; Composition of earth in comparison to other bodies in the solar system; Origin of hydrosphere and atmosphere, biosphere; Origin of oceans, continents and mountains; Age of the earth; Radioactivity and its application in determining the age of the earth; Rocks, minerals and fossils.

Unit-2

Earthquakes - causes, geological effects and their measurement, distribution of earthquake belts;Volcanoes -types, causes and geological effects, distribution of volcanic belts; Relationship of earthquakes with volcanic belts; Weathering and erosion; Soil, soil formation, soil profile and soil type; Geological time scale; Major events in the earth's history.

Section – B: Structural Geology

Unit-3

Topography and its representation; Dip and strike; Outcrop, effects of topography on outcrop; Forms of igneous rocks; Clinometer compass and its use; Folds, parts of fold, nomenclature and description of folds and causes of folding.

Unit-4

Faults - parts of faults, types of faults and causes of faulting; Joints- their geometric classification; Unconformity, its kinds and significance; Overlap; Outlier and inlier.

Books Recommended:

Physical Geology and Structural Geology

- Billings, M.P. (1972): Structural Geology, Prentice Hall.
- Dennis, J.G. (1972): Structural Geology, Ronald Press Company, NewYork.
- Hills, E.S. (1963): Elements of Structural Geology, Farrold and Sons, London.
- Holmes, Arthur (1992): Principles of Physical Geology, Vol. 1, Chapman and Hall, London.
- Leet, L.D. and Judson, S. (1969): Physical Geology, Prentice Hall.
- Ramsay, J.G. and Huber, M.I. (2000): Techniques of Modern Structural Geology, Vol. III, Academic Press.
- Ruhe, R.V. (1975): Geomorphology, Houghton Miffin Co., Boston.
- Singh, R. P. (1995): Structural Geology, A Practical Approach, Ganga Kaveri Publ., Varanasi.
- Sparks (1960): Geomorphology, Longmans, London.

Course No.GLB102: Practicals (connected with GLB101) (inclusive of Geological Field Training) Cr.: 2

Physical Geology:

Study of important geomorphological models; Reading topographical maps of the Survey of India; Elementary study of aerial photographs.

Structural Geology:
Study of clinometer compass; Exercises on structural problems; Completion of outcrops; Drawing and interpretation of sections across elementary representative geological structures.

SEMESTER – II

Course No. GLB201: ELEMENTS OF MINERALOGY AND CRYSTALLOGRAPHY Cr.: 4

Section – A: Introductory Mineralogy

Unit-1
Minerals, definition and classification; Processes of mineral formation (magmatic, post-magmatic, pegmatitic, weathering, sedimentary and metamorphic); Common physical properties of minerals (form and shape, colour, streak, luster, cleavage, fracture, hardness, tenacity, transparency, specific gravity, magnetic nature).

Unit-2
Chemical composition and diagnostic physical properties of rock forming minerals mentioned below: quartz, orthoclase, microcline, albite, labradorite, nepheline, muscovite, biotite, augite, hypersthene, tremolite, hornblende, olivine, serpentine, talc, chlorite, apatite, calcite, dolomite, garnet, kyanite, sillimanite, andalusite, staurolite, topaz, tourmaline, corundum, gypsum, graphite and kaolinite.

Section – B: Optical Mineralogy

Unit-3
Nature of Light, Optics of light, Critical Angle and Total Internal Reflection, Polarization of Light, Double refraction, Nicol Prism and its construction, Sample preparation techniques for optical microscopy, Polarizing microscope, its parts and functioning; Optically Isotropic and anisotropic substances, Common optical properties observed under polarized light and crossed nicols; Optical properties of some common rock forming minerals (quartz, orthoclase, microcline, plagioclase, garnet, biotite, muscovite, augite, hypersthene, hornblende, olivine and calcite).

Section – C: Introductory Crystallography

Unit-4
Crystal, elementary idea of crystal structure; Parts of crystal - face, edge, apex, solid angle and interfacial angle; Crystallographic axes and angles; Parameters and indices; Common crystal forms - dome, prism, pyramid and pinacoid; Elements of crystal symmetry; Introduction to different crystals systems.

Books Recommended:
Elements of Mineralogy and Crystallography

- Berry, L.G., Mason, B. and Dietrich, R.V. (1982): Mineralogy, CBS Publ.
- Dana, E.S. and Ford, W.E.(2002): A textbook of Mineralogy (Reprints).
- Nesse, D.W. (1986): Optical Mineralogy, McGraw Hill.
- Phillips, F.C (1971): Introduction to Crystallography,Longman Group Publ.
- Read, H.H. (1968): Rutley's Element of Mineralogy (Rev. Ed.), Thomas Murby and Co.

Course No.GLB202: Practicals (connected with GLB201) **Cr.: 2**

Mineralogy and Crystallography
Study of physical properties of minerals mentioned in theory course; Study of elements of symmetry of representative crystals from each system; Use of polarizing microscope; Study of optical properties of important rock forming minerals.

SEMESTER – III

Course No.GLB301: PETROLOGY AND ECONOMIC GEOLOGY **Cr.:4**

Section – A: Petrology

Unit-1: Igneous Petrology
Magma and its composition; Phase rule application to H2O system; Common textures; Magmatic differentiation and assimilation; Introduction to mineralogical classification; Brief petrographic description of common igneous rocks (granite, diorite, syenite, gabbro, dolerite, basalt, rhyolite, trachyte, pyroxenite and peridotite)

Unit-2: Sedimentary Petrology
Weathering and denudation of supra-crustal rocks; Origin of clastic and nonclastic sediments and genesis of sedimentary rocks; Primary sedimentary structures; Elementary idea about texture and mineral composition of clastic and nonclastic sedimentary rocks; General classification of sedimentary rocks; Descriptive petrography of fundamental rock types such as - conglomerate, breccia, sandstone, limestone and shale.

Unit-3: Metamorphic Petrology
Definition, types and agents of metamorphism; Classification of metamorphic rocks; Metamorphic textures and structures; Metamorphic zones and isograde; Progressive, regional and thermal metamorphism of pelitic, calcareous and basic igneous rocks; Common metamorphic rocks and their protoliths as given below: slate, phyllite, schist, gneiss, hornfels, marble, quartzite.

Section – B: Economic Geology

Unit-4
Definition of ore, ore mineral and gangue; Classification of ore deposits; Chemical composition, diagnostic characters, uses and distribution in India of the following minerals: magnetite, hematite, chromite, psilomalane, pyrolusite, chalcopyrite, galena, sphalerite, native gold, magnesite, bauxite, pyrite, diamond, muscovite, beryl, fluorite, gypsum, barite, halite, phosphorite, talc, kyanite, graphite, asbestos, monazite and corundum; Elementary idea regarding origin, uses and distribution of coal and petroleum in India.

Books Recommended:
Petrology and Economic Geology

- Best, Myron G.(2002): Igneous and Metamorphic Petrology, Blackwell Science.
- Blatt, H. and Tracy, R.J. (1996): Petrology (Igneous, Sedimentary, Metamorphic), W.H. Freeman and Co., NewYork.

- Brown, C. and Dey, A.K. (1955): Indian Mineral Wealth, Oxford Univ.
- Ehlers, E.G. & Blatt, H (1982): Igneous, Sedimentary and Metamorphic Petrology, CBS Publ.
- Huang: (1962): Petrology, McGraw Hill Book Co.
- Jense, M.L., Bateman, and A.M. (1981): Economic Mineral Deposits, John Wiley and Sons.
- Krishnaswamy, S. (1979): India's Minerals Resources, Oxford and IBH Publ.
- Nockold, Knox and Chinner (1978): Petrology for students, Cambridge Univ. Press.
- Sharma, N.L. and Ram, K.V.S. (1972): Introduction to India's Economic Minerals, Dhanbad Publ.
- Winkler, H. G.F. (1967): Petrogenesis of Metamorphic Rocks, Springer–Verlag.

Course No.GLB302: Practicals connected with GLB301 (inclusive of Geological Field Training)

Cr.: 2

Petrology

Megascopic and microscopic study of the following rock types:
granite, syenite, nepheline syenite, diorite, gabbro, peridotite, rhyolite, trachyte, dolerite, basalt, sandstone, limestone, conglomerate, breccia, gneiss, schist, quartzite, marble.

Economic Geology

Study of ore and economic minerals in hand specimens as detailed in the theory syllabus; Preparation of maps showing distribution of important metallic and non-metallic deposits and important coal and oil fields of India.

SEMESTER – IV

Course No. GLB401: PALEONTOLOGY AND STRATIGRAPHY **Cr.:4**

Section – A: Palaeontology

Unit-1

Paleontology, definition, subdivisions and scope, its relationship with other sub-disciplines of geology; Fossils, definition, characters, kinds; Conditions of fossilization; Incompleteness of fossil record; Elementary ideas about origin of life and adaptation to various environments.

Unit-2

Systematic classification of organisms; A detailed study of the morphology and geological distribution of Trilobita, Graptoloidea, Anthozoa and Echinoidea.

Section – B: Stratigraphy

Unit-3

Stratigraphy: Definition, its scope and relationships with other subdisciplines of geology; Principles of stratigraphy; Geological Time Scale; Stratigraphic classificaton; rock units, time units and time- rock units; Physical and structural subdivisions of India and their characteristics.

Unit-4
Stratigraphic approaches to study the Precambrian rocks of India with special reference to classification, lithology and economic significance - Dharwar of Karnataka Cuddapah of Telengana and Andhra Pradesh, Vindhyan of Son valley and Marwar Supergroup of Rajasthan.

Books Recommended:
Palaeontology and Stratigraphy

- Black, R.M. (1988): The Elements of Palaeontology, Cambridge Univ.
- Boggs, S. (2001): Principles of Sedimentology and Stratigraphy, Prentice Hall.
- Krishnan, M.S. (1968): Geology of India and Burma, Higgibothon, Madras.
- Kumar, R. (1985): Historical Geology and Stratigraphy of India, Wiley Eastern Ltd.
- Moore, R.C., Lalicker, C.G. and Fischer, A.G.(1997): Invertebrate Fossils, CBS Publ.
- Nield, E.W. and Tucker, V.C.T. (1985): Palaeontology: An Introduction, Pergmon Press.
- Prothero, D.R. (2004): Bringing Fossil to Life – An Introduction to Paleontology (2nd Ed.), McGraw Hill.
- Shrock, R.R. and Twenhoffel,W.H. (1952): Principles of Invertebrate Paleontology, CBS Publ.
- Wadia, D.N. (1966): Geology of India, English language Publ.
- Weller, J.M. (1960): Stratigraphic Principles and Practices, Universal Book.
- Woods, H. (1985): Palaeontology Invertebrate, CBS Publ.
- Jain, P.C. and Anantharaman, M.S. (1983): Palaeontology: Evolution and Animal Distribution, Vishal Publ.

Course No.GLB402: Practicals connected with GLB401 **Cr.: 2**

Palaeontology
Study of modes of preservation of fossils; Study of morphological characters of about 30 genera pertaining to Trilobita, Graptoloidea, Echinoidea and Anthozoa.

Stratigraphy
Preparation of lithostratigraphic maps of India showing distribution of the following - Dharwar Supergroup, Cuddapah Supergroup and Vindhyan Supergroup.Study of important rock types of the above mentioned stratigraphic units.

SEMESTER – V

Course No.501: PHYSICAL AND STRUCTURAL GEOLOGY **Cr.:4**

Section –A: Physical Geology

Unit-1
Exogenic and endogenic geomorphic processes; Evolution of landscape; A detailed account of the geological work of natural agencies - groundwater and springs, rivers, glaciers, lakes, ocean and wind.

Unit-2
Origin and classification of mountains; Concept and theories of isostasy; Origin and significance of mid oceanic ridges and trenches; Sea floor spreading & continental drift; Brief idea about plate tectonics and distribution of plates; Mitigation of environmental hazards - earthquakes, landslides, floods, basic concepts of remote sensing; Indian space mission; elements of photogeology.

Section –B: Structural Geology

Unit-3
Geological significance and recognition of unconformities; Fold morphology, geometric and genetic classifications, mechanics and causes of folding; Geometric and genetic classification of faults.

Unit-4
Effects of faulting on the outcrops; Geometric and genetic classification of joints; Foliation, descriptive terminology, origin and relation to major structures; Stereographic projection and its use in structural analysis.

Books Recommended:
Physical Geology and Structural Geology

- Billings, M.P. (1972): Structural Geology, Prentice Hall.
- Ghosh, S.K. (1993): Structural Geology, Pergamon Press, New York.
- Holmes, Arthur (1992): Principles of Physical Geology, Vol. 1, Chapman and Hall, London.
- Leet, L.D. and Judson, S. (1969): Physical Geology, Prentice Hall.
- Mallory, B.F and Cargo, D.N. (1979): Physical Geology, McGraw Hill.
- Monrow, James S. (1986): Physical Geology: Exploring the Earth, Booke Cole, Australia.
- Ramsay, J.G. and Huber, M.I. (2000): Techniques of Modern Structural Geology, Vol. III, Academic Press.
- Ritter, Dale F. (1986): Processes of Geomorphology. Wm C. Brown Publ.
- Singh, S (2001): Geomorphology, Prayag Pustak Bhandar, Allahabad
- Sitter, L.U. De (1959): Structural Geology, Mc Graw Hill Publ.
- Strahler, A. N. and Strahler, A.H. (1973): Environmental Geoscience, Hamilton Publ. Co.
- Turner, F.J. and Weiss, L.E. (1963): Structural Analysis of Metamorphic Tectonites McGraw Hill Book Co.

Course No. GLB502: IGNEOUS PETROLOGY, MINERALOGY, AND CRYSTALLOGRAPHY
Cr.: 4

Section - A: Igneous Petrology

Unit-1
Physical properties, genesis, evolution and types of magma; Concepts of rock series and rock association; Phase equilibrium in one (SiO_2), two (Di-An, Fo-Silica, Ab-An) and three (Di-Ab-An and Di-Fo-An) component silicate systems.

Unit-2
IUGS mineralogical (QAPF) and chemical (total alkali-silica diagram) classification schemes; Common igneous textures; Detailed petrographic description of granite, granodiorite, diorite, syenite, phonolilte, gabbro, norite, dolerite, basalt, andesiste, dunite, pyroxenite, peridotite, komatite, trachyte, rhyolite and dacite.

Section – B: Mineralogy and Crystallography

Unit-3
Classification of minerals; Introduction to crystal chemistry - Ionic size, packing, radius ratio and coordination number, solid solution; Isomorphism, polymorphism, diadochy, pseudomorphism, chemical bonds, Pauling's rules; Structural classification of silicates; Study of the following group of minerals with reference to chemical and structural formulae; Classification and occurrences - olivine, garnet, alumino-silciates, pyroxene, amphibole, mica, silica and feldspar.

Unit- 4
Introduction to 32 crystals classes of crystallography and description of the holosymmetric class; Contact goniometer; Angular measurement of crystal faces; Different types of crystal projections – spherical and stereographic and their uses; Electromagnetic spectrum, light, optics of light (reflection, refraction, Snell's law), dispersion, double refraction, sample preparation techniques for optical microscopy, refractive index liquids, Becke effect, relief, birefringence, retardation, pleochroism, extinction and interference colours; Classification of minerals into uniaxial and biaxial minerals.

Books Recommended:

- Berry, L.G., Mason, B. and Dietrich, R.V. (1982): Mineralogy, CBS Publ.
- Best, Myron G.(2002): Igneous and Metamorphic Petrology, Blackwell Science.
- Blatt, H. and Tracy, R.J. (1996): Petrology (Igneous, Sedimentary, Metamorphic), W.H. Freeman and Co., NewYork.
- Dana, E.S. and Ford, W.E.(2002): A textbook of Mineralogy (Reprints).
- Kerr, P. F. (1977): Optical Mineralogy, McGraw Hill.
- Moorhouse, W.W. (9151): Optical Mineralogy, Harper and Row Publ.
- Ness, D.W. (1986): Optical Mineralogy, McGraw Hill.
- Phillips, F.C. (1971): Introduction to Crystallography.
- Read, H.H. (1968): Rutley's Element of Mineralogy (Rev. Ed.), Thomas Murby and Co.
- Verma, A.R. and Srivastava, O.N. (1991): Crystallography of solid state Physics, New Age Int. Publ.

Course No.GLB503: SEDIMENTARY AND METAMORPHIC PETROLOGY Cr.:4

Section – A: Sedimentary Petrology

Unit-1
Processes of formation of sedimentary rocks; Classification of rudaceous, arenaceous, argillaceous and calcareous rocks; Structures of sedimentary rocks; Mineralogical characteristics, textures, and diagenesis of sedimentary rocks; Heavy minerals and provenance interpretations.

Unit-2
Petrographic details of important siliciclastic and carbonate rocks such as - conglomerate, breccia, quartzarenite, arkose, lithic arenite, quartzwake, felspathicwacke, lithicwacke, mudrocks / shale, limestones: crystalline, micritic and sparitic.

Section – B: Metamorphic Petrology

Unit-3
Phase rule and Goldschmidt's mineralogical phase rule; Principles of metamorphic reactions, metamorphic facies and metamorphic facies series; Graphical representation of mineral assemblages in ACF, AKF, AFM diagrams; Prograde, retrograde and polymetamorphism.

Unit-4
Progressisve metamorphism of (a) Pelitic rocks in K_2O – FeO-MgO-Al_2O_3-SiO_2 system, (b) Basic rocks in CaO – FeO – MgO – Al_2O_3 – SiO_2 system, (c) Calcareous rocks in CaO – MgO –SiO_2 – CO_2 – H_2O system; (d) Ultramafic rocks in MgO – Al_2O_3 – SiO_2 – H_2O system.

Books Recommended:

- Bucher, K. and Martin, F. (2002): Petrogenesis of Metamorphic Rocks (7th Rev. Ed.), Springer–Verlag.
- Ehler, E.G. and Blatt, H. (1982): Igneous, Sedimentary and Metamorphic Petrology, CBS Publ.
- Greensmith, J. T. (1984): Petrology of Sedimentary rocks, Thomas Murby Publ.
- Hatch, F.H., Rastall, R.H. and Black, M. : Petrology of Sedimentary Rocks, Thomas Murby Publ.
- Mason, R. (1978): Petrology of Metamorphic Rocks, CBS Publ.
- Pettijohn, F.J. (1957): Sedimentary rocks (3rd Ed.), Oxford Book Co.
- Winkler, H.G.C. (1967): Petrogenesis of Metamorphic Rocks, Narosa Publ.
- Yardlley, B.W.D. (1989): An introduction to Metamorphic Petrology, Longman Scientific and Technical, New York.

Course No.GLB504: Practicals (connected with GLB501) **Cr.: 1.5**

Physical Geology
Slope analysis from Topographical Maps. Interpretation of aerial photographs.

Structural Geology
Exercises on structural geology problems; Stereographic projection of structural data; Geometrical problems on folds and faults; Drawing and interpretation of profile sections across the geological maps.

Course No.GLB505: Practicals (connected with GLB502) **Cr.: 1.5**

Igneous Petrology
Megascopic and microscopic study of the igneous rocks as per list given in the theory paper.

Mineralogy
Study of the following silicate minerals with regards to their diagnostic physical properties -
Olivine Group, Garnet Group, Aluminosilicate Group, Staurolite, Topaz, Zircon, Epidote Group, Tourmaline, Beryl, Pyroxene Group, Amphibole Group, Mica Group, Talc, Serpentine, Chlorite, Kaolinite, Silica Group, Feldspar Group, Feldspathoid Group, Zeolite Group; A study of few models of silicate and non-silicate structures.

Optical Mineralogy
Optical study of few rock-forming minerals; Determination of length fast and length slow characters of minerals; Scheme of pleochroism, extinction.

Crystallography
A study of about 12 crystal models belonging to the seven crystal systems; Determination of axial ratio and face symbols of orthorhombic and monoclinic crystals, Stereographic projection of olivine and hornblende.

Course No.GLB506: Practicals (connected with GLB503) **Cr.: 1.5**

Megascopic and microscopic examination of conglomerate, breccia, quartz arenite, arkose, lithic arenite, quartzwacke, feldspathicwacke, lithicwacke (grewacke), mudrocks/shale and carbonates (micrite, sparite and accretionary limestones).
Examination of some common heavy minerals in grain mounts; Megascopic and microscopic study of metamorphic rocks - slate, phyllite, schist, gneiss, marble, quartzite, charnockite, hornfels, khondalite

Course No.GLB507: COMPULSORY GEOLOGICAL FIELD TRAINING **Cr.:4.5**

SEMESTER – VI

Course No.GLB601: PALEONTOLOGY **Cr.:4**

Unit-1
Application of paleontology in geological studies, Organic evolution - ancient and modern concepts, evidences, theories: Lamarckism and Darwinism.

Unit-2
Collection and preparation of macro- and micro– fossil; Binomial nomenclature and procedures in taxonomy; Concept of species; Skeletons and their compositions, development of individual organism.

Unit-3
Detailed study of morphological characters and geological distribution of the following invertebrate fossil groups -
Brachiopoda, Bivalvia, Gastropoda, Cephalopoda, Bryozoa and Crinoids.
Stratigraphic significance of ammonites and conodonts; Types of microfossils (calcareous, siliceous, phosphatic, chitinous, organic walled and agglutinated).

Unit-4
Modes of preservation and broad characteristics of plant fossils, Elementary knowledge of Gondwana flora.
Elementary ideas about vertebrate classes; Siwalik vertebrate fauna.

Books Recommended:

- Black, R.M. (1988): The Elements of Palaeontology, Cambridge Univ..
- Clarkson, E.N.K. (1986): Invertebrate Palaeontology and Evolution, Allen and Unwin Publ.
- Jain, P.C. and Anantharaman, M.S. (1983): Palaeontology: Evolution and Animal Distribution, Vishal Publ.
- Lehmann, U. (1983): Fossils Invertebrate, Cambridge Univ. Press.
- Moore, R.C., Lalicker, C.G. and Fischer, A.G.(1997): Invertebrate Fossils, CBS Publ.

- Nield, E.W. and Tucker, V.C.T. (1985): Palaeontology: An Introduction, Pergmon Press.
- Prothero, D.R. (2004): Bringing Fossil to Life – An Introduction to Paleontology (2nd Ed.), McGraw Hill.
- Rastogi (1988): Organic Evolution, Kedarnath and Ramnath Publ.
- Raup, D.M. and Stanley, S.M. (1985): Principles of Palaeontology, CBS Publ..
- Shrock, R.R. and Twenhoffel,W.H. (1952): Principles of Invertebrate Paleontology, CBS Publ.
- Stebbins (1979): Process of Organic Evolution (3rd Ed.) Prentice Hall.
- Woods, H. (1985): Palaeontology Invertebrate, CBS Publ.

Course No.GLB602: STRATIGRAPHY **Cr.: 4**

Unit-1

Facies concept in stratigraphy; Stratigraphic refinement and correlation; Elementary ideas about the sequence stratigraphy and paleobiogeographic reconstructions

Unit-2

Stratigraphy of the Palaeozoic of Kashmir and Gondwana Supergroup.

Unit-3

Classification, lithology and fossil content of Triassic of Spiti, Jurassic of Kachchh and Cretaceous of Tiruchirapalli.

Unit-4

A detailed study of succession, lithology,and fossil content of the following:
Deccan Trap and Intertrappean beds, Paleogene of Assam, Kachchh and Andaman, Siwaliks of Jammu and Himachal Pradesh and Karewas of Kashmir.

Books Recommended:

- Boggs, S. (2001): Principles of Sedimentology and Stratigraphy, Prentice Hall.
- Dunbar, C.O. and Rodgers, J. (1957): Principles of Stratigraphy, John Wiley and Sons.
- Krishnan, M.S. (1968): Geology of India and Burma, Higgibothon, Madras.
- Kumar, R. (1985): Historical Geology and Stratigraphy of India, Wiley Eastern Ltd.
- Wadia, D.N. (1966): Geology of India, English language Publ.
- Weller, J.M. (1960): Stratigraphic Principles and Practices, Universal Book.
- Valdiya, K.S. (2016) Geodynamic Evolution of India. Springer (2nd Edition).
- Krishna, J. (2017) The Indian Mesozoic Chronicle: Sequence Stratigraphic Approach. Springer, Singapore, 694 pages.
- Ramakrishna, M., Vaidyanadhan, R. (2010). Geology of India (Vol. 1 & 2), Geological Society of India, Bangalore.

Course No. GLB603: HYDROGEOLOGY, ENVIRONMENTAL GEOLOGY, EXPLORATION GEOLOGY AND COMPUTER APPLICATIONS **Cr.:4**

Unit-1

Definition of hydrogeology, geohydrology and hydrology; Hydrological cycle and groundwater in the hydrological cycle; Hydrological parameters - Precipitation, evaporation, transpiration and infiltration; Origin and age of groundwater; Vertical distribution of groundwater; Types of aquifers; Water bearing properties of rocks - Porosity and Permeability; Retention of water in rocks and yield of water from rocks;

Different types of springs and their formations; Darcy's law and its validity; Dissolved constituent of groundwater; Salinization of groundwater; Groundwater provinces of India.

Unit-2
Definition and dimensions of environment; General idea about components and composition of different environmental domains such as atmosphere, hydrosphere and biosphere; Types of environmental pollution; Introduction to weather and climate; Past-climates in the earth history; Concept and origin of monsoon; Elements of natural hazards.

Unit -3
Fundamentals of geological, geochemical and geophysical techniques employed in exploration of mineral deposits.

Unit-4
Elementary idea of computer knowledge in geological sciences; Use of MS-Excel and Power Point; Basic knowledge to graphics and drawing softwares (Adobe Illustrator, CorelDraw, Photoshop).

Books Recommended:

- Arogyaswamy, R.N.P. (1973): Courses in Mining Geology, Oxford and IBH Publ.
- Bryant, E. (1985): Natural Hazards, Cambridge Univ. Press.
- Chaussier, Jean – Bernard and Morer, J. (1987): Mineral Prospecting Manual., North Oxford Academic.
- Davies, S. N. and De Wiest, R. J. N. (1966): Hydrogeology, John Wiley and Sons.
- Dobrin, M. B., and Savit, C. H., (1988): Introduction to Geophysical Prospecting, McGraw-Hill Book Co.
- Karanth, K. R. (1989): Hydrogeology, Tata McGraw Hill Publ.
- Keller, E.A. (1978): Environmental Geology, Bell and Howell, USA.
- Lal, D. S. (2007): Climatology, Sharda Pustak Bhawan, Allahabad.
- Nagabhushaniah, H. S. (2001): Groundwater in Hydrosphere, CBS Publ.
- Raghunath, H. M. (1990): Groundwater, Wiley Eastern Ltd.
- Rajendran S. et al (2007) : Mineral Exploration : Recent Strategies.
- Telford, W.M., Geldart, L.P, Sheriff, R.E. and Keys, D.A. (1990): Applied Geophysics, Cambridge Univ. Press.
- Todd, D. K. (1995): Groundwater hydrology, John Wiley and Sons.
- Tolman, C. F. (1937): Groundwater, McGraw Hill Book Co.
- Valdiya, K.S. (1987): Environmental Geology – Indian Context, Tata McGraw Hill.

Course No.GLB604: ECONOMIC GEOLOGY **Cr.: 4**

Unit-1
Concept of ore, ore minerals and gangue in economic geology; Tenor of ores; Ore forming minerals – metallic and non-metallic; Common forms and structures of ore deposits; Paragenesis, paragenetic sequence and zoning in metallic ore deposits.

Unit-2
Processes of formation of ore deposits; Magmatic, contact metasomatic, pegmatitic, hydrothermal, sedimentation, residual concentration, mechanical concentration, oxidation and supergene suphide enrichment and metamorphism.

Unit-3
Study of important industrial minerals of India with particular reference to the industries - cement, glass and ceramics, refractory, fertilizer and building stones, chemicals and gemstones.

Unit-4
Processes of formation, geological occurrence, uses and distribution of coal and petroleum in India; A brief study of atomic fuels.

Books Recommended:

- Brown, C. and Dey, A.K. (1955): Indian Mineral Wealth, Oxford Univ.
- Gokhale, K.V.G.K. and Rao, T.C. (1983): Ore Deposits of India, East West Press Pvt. Ltd.
- Jense, M.L., Bateman, and A.M. (1981): Economic Mineral Deposits, John Wiley and Sons.
- Krishnaswamy, S. (1979): India's Minerals Resources, Oxford and IBH Publ.
- Mookherjee, A. (2000): Ore Genesis-A Holistic Approach, Allied Publisher.
- Sharma, N.L. and Ram, K.V.S. (1972): Introduction to India's Economic Minerals, Dhanbad Publ.

Course No.GLB605: Practicals (connected with GLB601) Cr.: 1.5

Study of morphological characters, systematic positions and age of about 30 representative genera belonging to the following groups - Brachiopoda, Bivalvia, Cephalopoda, and Gastropoda.
A detailed systematic description of the following genera -
Rhynchonella, Terebratula, Arca, Modiolus, Perisphinctes, Nautilus, Natica and Conus.

Course No.GLB606: Practicals (connected with GLB602) Cr.: 1.5

Distribution of following geological formations on sedimentary basin map of India -
Marine Lower Permian, Gondwana Supergroup, Marine Mesozoics, Deccan Traps and equivalents, Marine Cenozoic and Siwalik Group.
Preparation of land/sea distribution on sedimentary basin map of India during Late Precambrian/Early Cambrian, Early Permian, Jurassic, Cretaceous and Eocene; Study of rocks from important Indian stratigraphic horizons.

Course No.GLB607: Practicals (connected with GLB604) Cr.: 1.5

Study of ore and economic minerals in hand specimen as detailed in the theory syllabus; Preparation of maps showing distribution of important metallic and non-metallic deposits and important coal and oil fields of India.

Course No.GLB608: Assignment Cr.2.5
Assignment will be given to each student based on the marks/index of allotment in Honors in Geology.

ANCILLARY COURSE OFFERED BY DEPARTMENT OF GEOLOGY

Elements of Geology-I

Cr.:2

Unit 1:
Introduction to Earth Sciences, Scope, sub-disciplines and relationship with other branches of Science; Introduction to Geological Time Scale; Mass extension, Ice ages; Earthquakes: Type of seismic waves, focus, epicenter, types of earthquakes, causes of earthquakes, intensity and magnitude.

Unit 2:
Weathering and erosion; Geological work of river, wind and glaciers; Geological structures: Bedding, foliation, dip, struke; Folds and faults their parts, major types and geological significance; Plate tectonics and mountain building.

Unit 3:
A brief introduction and elementary classification of Igneous, sedimentary and metamorphic rocks; Minerals; Definition and elementary classification; physical properties of minerals; Diagnostic physical properties and chemical composition of some common rock forming minerals (Quartz, plagioclase, orthoclase, muscovite, biotite, augite, hornblende, tourmaline, garnet, calcite and olivine) and their varieties.

Elements of Geology-II

Cr.:2

Unit-I
Physical Divisions of India, Geological Time Scale, Principales of stratigraphy; stratigraphic units Representative lives of different geological periods, Mass extinction.

Unit-II
Paleontology-definition and scope; fossils-definition, conditions for fossilization, mode of occurrances and uses of fossils. Siwalik vertebrate fauna and their significance in paleoclimatic interpretations.