

REVISED SYLLABUS OF B.Sc. (GEOLOGY) COURSE (Course Curricula)

B. Sc. (Part I)			
a.	Theory Paper	Marks	Hrs./week
Paper-I	General Geology	30	2
Paper-II	Structural Geology	35	2
Paper-III	Crystallography and Mineralogy	35	2
b.	Practical	50	4
Total		150	10

B. Sc. (Part II)			
a.	Theory Paper	Marks	Hrs./week
Paper-I	Paleontology	35	2
Paper-II	Stratigraphy	30	2
Paper-III	Petrology	35	2
b.	Practical	50	4
Total		150	10

B. Sc. (Part III)			
a.	Theory Paper	Marks	Hrs./week
Paper-I	Economic Geology	35	2
Paper-II	Geochemistry and Geo-exploration	35	2
Paper-III	Environmental Geology and Remote Sensing	35	2
Paper IV	Geohydrology and Engineering Geology	35	2
b.	Practical		
I	Field Geology	35	8Hrs/day
II	General Viva-voce	50	--
Total		225	8+Field Geol.

SYLLABUS FOR B. Sc. (GEOLOGY) COURSE

(REVISED 2018)

B. Sc. PART-I

PAPER-I: GENERAL GEOLOGY

Geology and its branches, history of the earth and solar system, Basic principles of stratigraphy, geological timescale and rock record, rock and minerals. Weathering and erosion, natural water cycle and ground, geological action of river, wind, glacier and sea, Rock cycle, sedimentation and sedimentary rock, earth and life. Interior of earth, the internal heat of earth, age of earth, geodating techniques, formation of igneous rock, volcanism, plutonism and metamorphism, nature of seismic wave inside the earth, earth's magnetism and gravity, plate tectonics, deformation of the earth's crust, the plate in the solar system, a summary of the current knowledge, matter and energy of the earth.

Books Recommended:

- Holmes A. (1992): *Principles of Physical Geology (Vol. 1)*. Chapman and Hall, London. Van Nostrand Reinhold Co. Ltd., U.K., 832p. ISBN: 0-442-30780-2.
- Thornbury W.D. (1980): *Principles of Geomorphology*. Jhon Wiley and Sons, INC London, 631p.
- Leet L.D. and Judson S. (1969): *Physical Geology*. Prentice Hall, 484p. ISBN: 0136696988, 9780136696988.
- Ritter D.F. (2006): *Processes of Geomorphology*. Waveland Press, 560p. ISBN: 1577664612, 9781577664611.
- Sharma, H.S. (1990): *Indian Geomorphology*. Concept Publishing Co. New Delhi.358p.
- Singh S. (2001): *Geomorphology*. Prayag Pustak Bhandar, Allahabad, 613p.

PAPER-II: STRUCTURAL GEOLOGY

Outline of Structural Geology, Primary and Secondary structures, Importance of primary structures in structural geology (bedding, graded bedding, top and bottom criteria, cross stratification, ripple marks, sole marks pinch and swell structures, and primary volcanic and plutonic structures), Classification and significance of foliations and lineations, sedimentary structure of deformed origin, differential compaction, Fundamental deformed structures, Rheological properties of rocks with depth. Classification and Geometric and kinematic analyses of folds, penecontemporaneous folds, Nature of contacts (unconformities, Intrusive and faulted contacts), Recognition and classification of faults, dynamics analysis of faulting, Ductile Shear Zones, General characteristic of fractures and joints, Classification of joints and Joint related structures. Geotectonics and tectonic framework of India. Field evidences and identifications of structures.

Books Recommended:

- Davis G.H. and Reynolds S.J. (1996): *Structural Geology of Rocks and Regions*. John Wiley and Sons, Inc., 492p. ISBN- 047152621-5.
- Hatcher R.D. (1995): *Structural geology, principles, concepts and problems*. Prentice Hall, 525p. ISBN-0023557133.
- Ghosh S.K. (1993): *Structural Geology, Fundamentals and modern developments*. Peramon Press, 598p. ISBN-0080418791.

- Ghosh S.K. and Sengupta S. (1997): *Evolution of geological structures in micro- to macro-scales*. Springer, Berlin. 446p. ISBN-0412750309.
- Ramsay J.G. and Huber M.I. (2003): *The Techniques of Modern Structural Geology (Volume 1): Strain Analyses*. Academic Press, 305p. ISBN-0-12-576921-0.
- Ramsay J.G. and Huber M.I. (2003): *The Techniques of Modern Structural Geology (Volume 2): Folds and Fracture*. Academic Press, 697p. ISBN-0-12-576902-4.
- Marshak S. and Mitra G. (1988): *Basic Methods of Structural Geology*. Prentice Hall, 446p. ISBN-0130651788.
- Lisle R.J. (2003): *Geological Structures and Maps: A Practical Guide*. Butterworth-heinemann, 124p. ISBN-0750657804.
- Park R.G. (2004): *Foundation of Structural Geology*. Routledge, 202p. ISBN-074875802X
- Fossen H. (2010): *Structural Geology*. Cambridge University Press, 463p. ISBN-9780521516648.
- Pollard D.D. and Fletcher R.C. (2005): *Fundamentals of Structural Geology*. Cambridge University Press, New York, 500p. ISBN-10 0-521-83927-3.
- Ragan D.M. (2009): *Structural Geology: An Introduction to Geometrical Techniques*. Cambridge University Press, 602p. ISBN-0521897580.

PAPER-III: CRYSTALLOGRAPHY AND MINERALOGY

Introduction to fundamentals of Crystals: bonding, chemistry, solid solution, polymorphism, isomorphism, pseudomorphism; their faces, forms and laws of crystallography, Miller notation, symmetry elements, study of crystal forms of all seven crystal systems, twinning and its important laws, common types of twins and their examples in minerals. Hermann–Mauguin symbols, crystal projections: spherical and stereographic projection and their uses, liquid crystals and their applications, principles of optics, use of petrological microscope, concept of indicatrix and optic axis figure. Structure, chemistry and phase equilibria study of common rock-forming minerals.

Books Recommended:

- Berry L.G., Mason B. and Dietrich R.V. (1982): *Mineralogy*. Freeman, San Francisco, 561p. ISBN: 0716714248.
- Dana E.S. and Ford W.E. (2002): *A textbook of Mineralogy*. J. Wiley and Sons, 851p.
- Nesse D.W. (1986): *Optical Mineralogy*. McGraw Hill, Oxford Univ Pr., 364p. ISBN: 0195391152, 9780195391152.
- Phillips F.C (1971): *Introduction to Crystallography*. Longman Group Publ., Read Books Design, 312p. ISBN: 1447417003, 9781447417002.
- Read H.H. (1968): *Rutley's Element of Mineralogy (Rev. Ed.)*. Thomas Murby and Co. 560p. ISBN: 0045490058, 9780045490059.
- Deer W.A., Howie R.A. and Zussman J. (1996): *An Introduction to the Rock-Forming Minerals*. Prentice Hall, Longman Scientific and Technical, London, 696p. ISBN: 0582300940, 9780582300941.
- Bloss F.D. (1971): *Crystallography and Crystal Chemistry*. Holt, Rinehart and Winston, New York, 545p. ISBN: 0030851556 (0-03-085155-6).
- Klein C. and Hurlbut C.S. (1993): *Manual of Mineralogy*. John Wiley and Sons, New York. 681p. ISBN: 0471312665, 9780471312666.

PRACTICALS:

a) **Crystallography & Mineralogy:**

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 and an introduction to gem stones and gems.

b) **Structural Geology:**

Problems of dip strike and thickness of bed, Study of some primary (bedding, cross-bedding, ripple marks, salt pseudomorphs etc.) and deformed structures (folds, faults, joints, foliation and lineations) in meso-scopic scale, contour maps and completion of outcrops, study and interpretation of topographical maps, geological maps and section including geological history, stereographic projection.

Field studies

B. Sc. PART-II

PAPER-I: PALEONTOLOGY

Paleontology: Definition, subdivision and scopes. Fossils: Definition, character and kinds (body and trace) and applications. Conditions and modes of fossilization. Classification and nomenclature. Living and derived fossils. Collection and preparation of fossils.

Study of morphological characters and geological distribution of the following invertebrate groups; Brachiopoda, Bivalvia, Gastropoda, Cephalopoda, Echinoidea and Trilobita.

Elementary idea about different types of microfossils (calcareous, siliceous, phosphatic and organic-walled) and their applicability. A brief outline of vertebrate fossils with special reference to the Siwalik fauna. Study of Gondwana plant fossils.

Books Recommended:

Moore R.C., Lalicker C. G. and Fischer A.G. (1997): *Invertebrate Fossils*. CBS Publ., New Delhi. 766p. ISBN 8123911394.

Shrock R.R. and Twenhofel W. H. (1999): *Principles of Invertebrate Paleontology*. CBS Publ., New Delhi. 816p. ISBN: 075818395X, 9780758183958.

Jain P.C. and Ananthraman M.S. (2010): *Palaeontology: Evolution and Animal Distribution*. Vishal Publ. Co., Delhi.

Wood H. (1997): *Paleontology Invertebrate (9th Edition)*. CBS Publ., N. Delhi.

Kathal P.K. (2012): *Applied Geological Micropaleontology*. Scientific Publishers, Jodhpur, India. ISBN817233754X, 9788172337544.

PAPER-II: STRATIGRAPHY

Introduction; Stratigraphic Principles, Classification and Nomenclature; Litho-, Chrono- and Biostratigraphy; Stratigraphic Correlation.

Precambrian Stratigraphy- Dharwar Province, Singhbhum Region, Central India; Cuddapah and Vindhyan Supergroups.

Phanerozoic Stratigraphy- Stratigraphic succession, Lithology and Fossil characteristics of important Paleozoic, Mesozoic and Cenozoic formations in India. Gondwana and Siwalik Groups. Deccan Trap.

Books Recommended:

- Kumar R. (2007): *Fundamental of Historical Geology and Stratigraphy of India*. New Age Intntl. Pvt. Ltd. Publishers, New Delhi. 254p. ISBN: 0852267452, 9780852267455.
- Krishnan M.S. (1998): *Geology of India and Burma*. CBS Publishers, Delhi. 536p. ISBN: 8123900120, 978-8123900124.

PAPER-III: PETROLOGY

Introduction to petrology, Classification of rocks and their surface abundance. Rock Cycle. Igneous rocks: forms, textures, structures and micro-textures, crystallization of magma: One component (SiO₂), Two component (Di-An, MgO-SiO₂ and Ab-An systems) and multi component systems (Di-Ab-An and Ne-Ks-SiO₂). Various classification of igneous rocks, Peacocks index; Causes of diversity in igneous rocks; Petrographic province and Harker Variation diagram; Study of following rock-types: Basalt, Gabbro. Rhyolite, Granite, Syenite, Andesite, Peridotite, Dunite, Komatiite, Kimberlite, and lamprophyres.

Nature and origin of sedimentary rocks, classification of sedimentary rocks, sandstone, conglomerate, shale and limestone; Textures of sedimentary rocks, Provenance, Introduction to hydraulics of open channel flows; Sedimentary structures, Diagenesis; Introduction to sedimentary basins, Concept of Geosyncline; Introduction to depositional environments and facies.

Metamorphic rocks: definition and types of metamorphism, texture, fabric and structures in metamorphic rocks, basic concepts of metamorphic zones, facies and grades, anatexis, metamorphism of different rock types; Study of various metamorphic rocks: Gneiss, Schist, Slate, Phyllite, Amphibolite, Granulite, Khondalite and Charnockite.

Books Recommended:

- Best M.G. (2002): *Igneous and Metamorphic Petrology*. Blackwell Science Ltd., 752p. ISBN: 1-40510-588-7.
- Winter J.D. (2001): *An introduction to Igneous and Metamorphic Petrology*. Prentice-Hall India, New Delhi, 702p. ISBN: 0321592573, 9780321592576.
- Sengupta S.M. (2007): *Introduction to sedimentology*. CBS Publ., New Delhi, 339p. ISBN 81-239-1491-1.
- Prothero D.R. and Schwab F. (2004): *Sedimentary Geology*. W.H. Freeman, 557p. ISBN: 0716739054, 9780716739050.

PRACTICAL:

a) **Paleontology**

Study of modes of preservation of given fossil specimens. Study of morphological characters of various invertebrate fossil genera. Morphological study of some Gondwana plant fossils. Microscopic study of various types of microfossils.

b) **Petrology**

Study of rocks in hand specimens and in thin sections: igneous, metamorphic and sedimentary; Preparation of thin sections; Study of sedimentary structures; Clastic grain-size analysis. Roundness and shape analyses of clastic grains.

B. Sc. PART-III

PAPER-I: ECONOMIC GEOLOGY

Mode of occurrence, origin, classification of ore deposits (Magmatic, Metamorphic, Hydrothermal; Oxidation and Supergene Enrichment and Sedimentary), Geothermometry. Introduction to ore microscopy. Prospecting and exploration: Forms of ore deposits, grade, volume and tonnage estimations for ore deposits. Stratiform and stratabound ores, Metallogenetic epochs and provinces of India, Origin and distribution of copper iron, manganese, aluminium, lead and zinc, asbestos, barytes, gypsum, graphite, apatite and beryl deposit of India. Strategic, essential and critical minerals with examples. Introduction to Coal and Petroleum, Coal and petroleum deposits of India. Raw material for ceramic, cement, refractory and glass industries and building stones.

Books Recommended:

- Prasad U. (2003): *Economic geology*. CBS Publishers and Distributors, 300p. ISBN: 8123904606, 9788123904603.
- Gokhale K.V.G.K. and Rao T.C. (1983): *Ore Deposits of India*. East West Press Pvt. Ltd., p. 226p.
- Jense M.L. and Bateman A.M. (1981): *Economic Mineral Deposits*. John Wiley and Sons. 593p. ISBN: 0471090433, 9780471090434.
- Krishnaswamy S. (1979): *India's Minerals Resources*. Oxford and IBH Publ. 658p.
- Sharma N.L. and Ram K.V.S. (1972): *Introduction to India's Economic Minerals*. Dhanbad Publ. 258p.

PAPER-II: GEOCHEMISTRY AND GEOEXPLORATION

Introduction, cosmic abundance of elements, composition of planets and meteorites, structure and composition of earth and distribution of elements, elementary crystal chemistry and thermodynamics, introduction to isotope geo-chemistry, geochemical cycle. Principles of geochemical exploration, sampling, path finders, primary and secondary dispersion, geobotanical survey, geophysical methods of prospecting (gravity, magnetic, electrical, seismic and radioactive). Stage of mineral exploration, classification of reserves.

Books Recommended:

- Rajendran S.S., Srinivasamoorthy K. and Aravindan S. (2007): *Mineral Exploration: Recent Strategies*. New India Publishing Agency, 528p. ISBN: 81-89422-71-5.
- Dobrin M.B. and Savit C.H. (1988): *Introduction to Geophysical Prospecting*. McGraw-Hill Book Co. 867p. ISBN: 0070171963, 9780070171961.
- Mason B. and Moore C.B. (1991): *Introduction to Geochemistry*. Wiley Eastern, 344p. ISBN: 0471575224, 9780471575221.

PAPER-III: ENVIRONMENTAL GEOLOGY AND REMOTE SENSING

Concepts and principles of environmental geology, natural hazards- prevention and precautions (earthquakes, floods, landslides, river and coastal erosion), impact assessment of urbanization, open cast mining and quarrying, river valley projects, disposal of industrial and radioactive waste, excess withdrawal of ground-water, use of fertilizers, dumping of ore, mine waste and fly ash, organic and inorganic contamination of groundwater and their remedial measures, soil degradation and remedial measures. Concept and principles of aerial photography and photogrammetry, satellite remote sensing- data products and their interpretation, digital image

processing, remote sensing in landform and land use mapping, structural mapping, hydrogeological studies and mineral exploration, Geographic Information System (GIS)–principles and applications.

Books Recommended:

- Bryant E. (1985): *Natural Hazards*. Cambridge Univ. Press., 312p. ISBN: 0-521-53743-6.
- Keller E.A. (1978): *Environmental Geology*. Bell and Howell, USA, Prentice Hall, 596p. ISBN: 0321643755, 9780321643759.
- Valdiya K.S. (1987): *Environmental Geology–Indian Context*. Tata McGraw Hill Pub. Co., 583p.
- Lillesand T.M. and Kiefer R.W. (1987): *Remote Sensing and Image Interpretation*. John Wiley, 820p. ISBN: 81-265-1335-7.
- Siegal B.S. and Gillespie A.R. (1980): *Remote Sensing in Geology*. John Wiley, 702p. ISBN: 0471790524, 9780471790525.
- Gupta R.P. (1991): *Remote Sensing Geology*. Springer, Berlin. 655p. ISBN: 3-540-43185-3.

PAPER-IV: GEOHYDROLOGY AND ENGINEERING GEOLOGY

Hydrological Cycle. Origin of water, meteoric, juvenile, magmatic and sea waters, precipitation, runoff, infiltration, evapotranspiration, hydrographs, classification of aquifers, hydrological properties of rocks (specific yield, specific retention, porosity, permeability, hydraulic conductivity, transmissivity, storage coefficient), Darcy's law, water table fluctuations–causes, Groundwater provinces of India.

Mechanical properties of rocks and soils, geological investigations for river valley projects–dams, and reservoirs. Tunnels–types, methods and problems. Bridges–types and foundation problems. Landslides–classification, causes and prevention and rehabilitation, concrete aggregates–sources, alkali–aggregate reaction. Geotechnical case studies of major projects in India–in brief.

Books Recommended:

- Todd D.K. (1995): *Groundwater Hydrology*. John Wiley and Sons, 556p. ISBN: 81-26508361.
- Karanth K.R. (1989): *Hydrogeology*. Tata McGraw Hill Publ., 458p. ISBN: 0074601806, 9780074601808.
- Raghunath H.M. (1990): *Groundwater*. Wiley Eastern Ltd., 520p.
- Krynine D.H. and Judd W.R. (1998): *Principles of Engineering Geology*. CBS Edition.
- Schultz J.R. and Cleaves A.B. (1951): *Geology in Engineering*. John Willey & Sons, New York, 592p.
- McKinstry H.E. (1948): *Mining Geology*. Prentice Hall, Englewood Cliffs N.J., 680p.

PRACTICAL

I: FIELD GEOLOGY

Students will be required to carry out fieldwork for 1-2 weeks in suitable geological areas to study various aspects of field geology and submit a report thereon.

II: VIVA-VOCE
