FS B.Sc. – I (Major/Minor/MDC)

	The Maharaja Sayajirao University of Baroda **Faculty of Science** **Department of Geology** **Sayajigunj, Vadodara, 390002**		ACADEMIC YEAR 2023-2024	
B.Sc. (Geology): Regular Programme				
YEAR	I	**Major (Compulsory)** **GLM 2001C Fundamentals of Earth Processes**	CREDIT	4
Semester	I		HOURS	75

OBJECTIVES:	The objective of this course is to provide the students an understanding of the geological characteristics of the planet earth, its surface morphology, stratigraphic principles and minerals.

COURSE CONTENT / SYLLABUS

UNIT-I	Definition, scope, and branches of geo-science; Solar system: origin and important theories – Evolutionary and catastrophic theories; Age of the Earth: Relative methods– from organic evolution, rate of sedimentation, salinity of sea water and rate of cooling and absolute methods of dating - radiometric dating; Earth's internal structure; Concept of isostasy – Pratt's and Airy's Hypothesis.	15 hrs.
UNIT-II	Fundamental concepts of geomorphology; Endogenic and exogenic processes; Weathering – Physical, Chemical, and biological; Soil – its development and profile, Drainage patterns	15 hrs.
UNIT-III	Definition and importance of stratigraphy in geology; Geological time scale; Brief idea about stratotypes; imperfection of geological records; Principles of Stratigraphy; Stratigraphic units - Lithostratigraphy, biostratigraphy and chrono stratigraphy.	15 hrs.
UNIT-IV	Study of physical properties of minerals in hand specimen. (Lab)	30 hrs.

REFERENCES

1) Leet, L. D., Judson, S., & Kauffman, M. E. (1954). Physical geology. Prentice-Hall.
2) Jain, S. (2014). Fundamentals of physical geology. Springer India.
3) Thornbury, W. D. (1954). Principles of geomorphology (Vol. 78, No. 2, p. 157). LWW.
4) Kale, V. S., & Gupta, A. (2001). Introduction to geomorphology. Orient Longman.
5) Weller, M.J. Stratigraphic principles, and practice.
6) International Commission on Stratigraphy https://stratigraphy.org/

	The Maharaja Sayajirao University of Baroda **Faculty of Science** **Department of Geology** **Sayajigunj, Vadodara, 390002,**		ACADEMIC YEAR 2023-2024
B.Sc. (Geology): Regular Programme			
YEAR	I	**Major (Compulsory)**	CREDIT 4
Semester	I	**GLM 2011C Introduction to Minerals and Fossils**	HOURS 75
OBJECTIVES:	The objective of this course is to develop an understanding of the crystals and minerals through models and hand specimens. The course will also help in introducing the students to the subject of palaeontology.		

COURSE CONTENT / SYLLABUS		
UNIT-I	Crystal - Crystallization, morphology (faces, edge, solid angle), elements of symmetry (Plane, axis and centre); Crystallographic axes & Crystal systems; Weiss parameters and Miller indices; Interfacial angles and open & closed crystal forms.	15 hrs.
UNIT-II	Minerals – definition, nature; chemistry and classification - rock forming and ore-forming minerals; physical properties of minerals; Basic idea about the rock forming mineral groups (silicates) and their gem varieties.	15 hrs.
UNIT-III	Palaeontology - Fossils Definition; Preservations of fossils (nature of hard parts, modes of preservation) occurrences of Fossils; Types of Fossils – Body fossil - Mega and Micro Fossils; Living Fossils; Resin Fossils; Pseudo-fossils; derived and transported fossils; Trace Fossils; Concept of index fossils; Utility of Fossils.	15 hrs.
UNIT-IV	Study of symmetry elements of normal classes of six crystal systems, Euler's theorem. (Lab)	30 hrs.

REFERENCES

1) Hurlbut, C. S., & Klein, C. (1977). Manual of mineralogy (after James D. Dana). Wiley.
2) Perkins, D. (1998). Mineralogy. Begin, 17, 17-38.
3) Rutley, F. (2012). Rutley's elements of mineralogy. Springer Science & Business Media
4) An Introduction to Palaeontology, Amal Dasgupta. The World Press Private Limited
5) Palaeontology evolution and animal distribution, P.C. Jain.
6) Black, R. M. (1999) Elements of Palaeontology, Cambridge University Press

	The Maharaja Sayajirao University of Baroda **Faculty of Science** **Department of Geology** **Sayajigunj, Vadodara, 390002,**	ACADEMIC YEAR 2023-2024

B.Sc. (Geology): Regular Programme

YEAR	I	**Minor**	CREDIT	4
Semester	I	**GLE2001C Fundamentals of Earth Processes and Mineral Science**	HOURS	60

OBJECTIVES:	The course is meant to introduce the students to planet earth, its surface processes, minerals and crystals.

COURSE CONTENT / SYLLABUS

UNIT-I	Definition, scope and branches of geo-science; Solar system: origin and important theories – Evolutionary and catastrophic theories; Age of the Earth: Relative methods– from organic evolution, rate of sedimentation, salinity of sea water and rate of cooling and absolute methods of dating - radiometric dating; Earth's internal structure; Concept of isostasy – Pratt's and Airy's Hypothesis.	15 hrs.
UNIT-II	Fundamental concepts of geomorphology; Endogenic and exogenic processes; Weathering – Physical, Chemical, and biological; Soil – its development and profile; Marine, Fluvial, Aeolian, and Glacial processes and resulting landscapes.	15 hrs.
UNIT-III	Crystal - Crystallization, morphology (faces, edge, solid angle), elements of symmetry (Plane, axis and centre); Crystallographic axes & Crystal systems; Weiss parameters and Miller indices; Interfacial angles and open & closed crystal forms.	15 hrs.
UNIT-IV	Minerals – definition, nature; chemistry and classification - rock forming and ore-forming minerals; physical properties of minerals; Basic idea about the rock forming mineral groups and their gem varieties– Silicates structures.	15 hrs.

REFERENCES

1) Leet, L. D., Judson, S., & Kauffman, M. E. (1954). Physical geology. Prentice-Hall.
2) Jain, S. (2014). Fundamentals of physical geology. Springer India.
3) Thornbury, W. D. (1954). Principles of geomorphology (Vol. 78, No. 2, p. 157). LWW.
4) Kale, V. S., & Gupta, A. (2001). Introduction to geomorphology. Orient Longman.
5) Weller, M.J. Stratigraphic principles, and practice.
6) International Commission on Stratigraphy https://stratigraphy.org/
7) Hurlbut, C. S., & Klein, C. (1977). Manual of mineralogy (after James D. Dana). Wiley.
8) Perkins, D. (1998). Mineralogy. Begin, 17, 17-38.
9) Rutley, F. (2012). Rutley's elements of mineralogy. Springer Science & Business Media.

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B.Sc. (Geology): Regular Programme				
YEAR	I	**Minor**	CREDIT	2
Semester	I	**SEC 2181C Mineral Science Lab (SEC)**	HOURS	60

OBJECTIVES:	The objective of this laboratory course is to develop hands on skill in the students to identify and characterize crystals and minerals.

COURSE CONTENT / SYLLABUS

UNIT-I	Study of symmetry elements of normal classes of six crystal systems, Euler's theorem.	30 hrs.
UNIT-II	Study of physical properties of minerals in hand specimen.	30 hrs.

	The Maharaja Sayajirao University of Baroda **Faculty of Science** **Department of Geology** **Sayajigunj, Vadodara, 390002,**	ACADEMIC YEAR 2023-2024

B.Sc. (Geology): Regular Programme

YEAR	I	**Multidisciplinary Course (MDC-I)**	CREDIT	4
Semester	I	**MDC2221C Mineral Science**	HOURS	75

OBJECTIVES:	This course will provide information about the multiple facets of minerals and their uses.

COURSE CONTENT / SYLLABUS

UNIT-I	Minerals- Introduction, classification, basic physical properties; Mineral chemistry and structure of common occurring minerals; Mineral, Man and Environment-health hazards from natural minerals, Impact of Mining and Mineral Industry on environment, concept of medicinal mineralogy.	15 hrs.
UNIT-II	Basic idea and occurrences of economic minerals - Non-metallic, metallic, mineral fuels in Gujarat. Minerals and corresponding industries - ceramics and refractories, electronics, paint, and coatings and other industrial applications;	15 hrs.
UNIT-III	Gemstones- Introduction, qualities of gemstones, geological distribution, gem testing techniques, gems, and jewelry; contribution of gems in medical science.	15 hrs.
UNIT-IV	Study of physical properties of minerals in hand specimen. (Lab)	30 hrs.

REFERENCES

1) Rutley, F. (2012). Rutley's elements of mineralogy. Springer Science & Business Media.
2) Ciullo, P. A. (1996). Industrial minerals and their uses: a handbook and formulary. William Andrew.
3) Mukherjee, S. (2012). Applied mineralogy: applications in industry and environment. Springer Science & Business Media.
4) Karanth, R. V. (2000). Gems and gem industry in India (No. 45). Geological Society of India.
5) Prasad, U. (2006). Economic Geology: Economic Mineral Deposits. CBS Pub.

	The Maharaja Sayajirao University of Baroda **Faculty of Science** **Department of Geology** **Sayajigunj, Vadodara, 390002**	ACADEMIC YEAR 2023-2024

B.Sc. (Geology): Regular Programme

YEAR	I	**Indian Knowledge System** **IKS2161C Geoheritage**	CREDIT	2
Semester	I		HOURS	50
OBJECTIVES:	The purpose of this course is to develop concept of geoparks and preservation of geo-sites and geo-heritage among the students.			

COURSE CONTENT / SYLLABUS

UNIT-I	Introduction and importance of geo-heritage. Concept, geo-conservation, guideline for selection and development strategies. Types of geoparks: fossil parks, rock monuments, geological marvels, stratigraphic and economic. Threats to geodiversity; conservation, protection, and maintenance of geological sites. Geotourism – tourism and geosciences, geological heritage and museums.	15 hrs.
UNIT-II	UNESCO geoparks and national geological monuments. Well-known geoparks and geosites in various states of India. National and global geoheritage and protection laws.	15 hrs.

REFERENCES

1) A Monograph on National geoheritage monuments of India, Indian National Trust for Art and Cultural Heritage, Natural Heritage Division, New Delhi. 2016.
2) Ranawat, P. S., George, S., 2019 Potential Geoheritage & Geotourism Sites in India, International Journal of Scientific & Research Publications, Volume 9 (6). pp. 91-96.
3) Ezzoura Errami, Margaret Brocx (Ed.) 2009. Geoheritage, Geoparks and Geotourism Conservation and Management Series, Springer. P 268.
4) Geoheritage and Potential Geotourism in Geoparks- Indian Perspective, Wadhawan S. K. in Global Geographical Heritage, Geoparks and Geotourism, Singh, R. B., Wei, D., and Anand S., Springer Nature, 2021.

SS B.Sc. – I (Major/Minor/MDC)

<table>
<tr><td></td><td colspan="3">The Maharaja Sayajirao University of Baroda
Faculty of Science
Department of Geology
Sayajigunj, Vadodara, 390002,</td><td>ACADEMIC YEAR 2023-2024</td></tr>
<tr><td colspan="5">B.Sc. (Geology): Regular Programme</td></tr>
<tr><td>YEAR</td><td>I</td><td rowspan="2">Major (Compulsory)
GLM2002C Introduction to Rock Science</td><td>CREDIT</td><td>4</td></tr>
<tr><td>Semester</td><td>II</td><td>HOURS</td><td>75</td></tr>
<tr><td colspan="2">OBJECTIVES:</td><td colspan="3">The objective of this course is to provide theoretical and practical knowledge to the students for identifying and describing various rock types and structures.</td></tr>
<tr><td colspan="5">COURSE CONTENT / SYLLABUS</td></tr>
<tr><td>UNIT-I</td><td colspan="3">Rocks as natural mineral aggregates; types of rocks and concept of rock cycle; Magma definition, composition, types and origin; Major forms and structures of igneous rocks; Tabular classification of igneous rocks; Ideas about diversity in igneous rocks – differentiation and assimilation, Bowen’s reaction series; Occurrences of Granite, Granodiorite, Rhyolite, Syenite, Nepheline syenite, Phonolite, Diorite, Gabbro, Basalts, Carbonatites in India.</td><td>15 hrs.</td></tr>
<tr><td>UNIT-II</td><td colspan="3">Sedimentary rocks- Processes of formation, Concept of grain size and shape, common primary sedimentary structures, Basic classification of sediments and sedimentary rocks; Metamorphic rocks- Agents and types of metamorphism, structures and classification, Concept of index minerals and grade of metamorphism; Occurrences of common sedimentary and metamorphic rocks in India.</td><td>15 hrs.</td></tr>
<tr><td>UNIT-III</td><td colspan="3">Definition and types of deformation in rocks; planer and linear structures; attitudes of planer and linear structures - its measurements and related symbols; Basic understanding of folds, faults, joints and unconformity; Basic Geological tools – hammer, clinometer, Brunton compass and topographical maps; Working principle of GPS.</td><td>15 hrs.</td></tr>
<tr><td>UNIT-IV</td><td colspan="3">Megascopic studies of common igneous, sedimentary, and metamorphic rocks. (Lab)</td><td>30 hrs.</td></tr>
<tr><td colspan="5">REFERENCES</td></tr>
<tr><td colspan="5">1) Tyrrell, G. W. (2012). The principles of petrology: an introduction to the science of rocks. Springer Science & Business Media.
2) Sengupta, S. (2017). Introduction to sedimentology. Routledge.
3) Billings, M. P. Structural Geology, Prentice Hall, 1977
4) Mathur, S. M. (2001). Guide to Field Geology. PHI Learning Pvt. Ltd.</td></tr>
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	The Maharaja Sayajirao University of Baroda **Faculty of Science** **Department of Geology** **Sayajigunj, Vadodara, 390002,**	ACADEMIC YEAR 2023-2024

B.Sc. (Geology): Regular Programme

YEAR	I	**Major (Compulsory)**	CREDIT	4
Semester	II	**GLM2012C Applications of Geoscience**	HOURS	75

OBJECTIVES:	The objective of this course is to give an idea about the fundamental aspects of applied geology and provide outdoor training for carrying out geological studies.

COURSE CONTENT / SYLLABUS

UNIT-I	Role of geo-science and geo-scientists in society- industrial and economic significance; Mining – introduction and terminologies; preliminary idea about open cast and underground mining;	15 hrs.
UNIT-II	Concepts and principles of environmental geology; Natural environmental hazards-Causes and preventive measures of floods, mass-movement, earthquakes, tsunami, and cyclones.	15 hrs.
UNIT-III	Groundwater – hydrological cycle, societal relevance, vertical distribution; hydrogeological classification – aquifer, aquitard, aquiclude, aquifuge; WHO and BIS standards of water quality. Role of different rocks as construction material - Building stones, Roofing and facing stones, Armour-stone, concrete aggregate, road aggregate.	15 hrs.
UNIT-IV	Study of SOI topographic maps. Methods and techniques of extracting geological information and interpretation from topographic maps to identify geomorphic and structural features. Hands on training of basic geological tools such as Hammer, Brunton compass and GPS in lab. Outdoor practicals in igneous, sedimentary and metamorphic terrains and use of basic geological tools. (Lab)	30 hrs.

REFERENCES

1) Arogyaswamy, R. N. P. (1980). Courses in mining geology. Oxford and IBH.
2) Todd, D. K., & Mays, L. W. (2004). Groundwater hydrology. John Wiley & Sons.
3) Keller, E. A. (2007). Introduction to environmental geology. Prentice-Hall, Inc.
4) Prentice John Edward (1982). Geology of construction materials, Chapman and Hall, London
5) Compton, R. R. (1962). Manual of field geology. Soil Science, 93(4), 295.

	The Maharaja Sayajirao University of Baroda Faculty of Science Department of Geology Sayajigunj, Vadodara, 390002,	ACADEMIC YEAR 2023-2024

B.Sc. (Geology): Regular Programme

YEAR	I	Minor	CREDIT	4
Semester	II	**GLE2002C Fundamentals of Rock Science and Historical Geology**	HOURS	60
OBJECTIVES:		This course will enable students to identify various types of rocks, structures, fossils and understanding stratigraphic principles.		

COURSE CONTENT / SYLLABUS

UNIT-I	Rocks as natural mineral aggregates; types of rocks and concept of rock cycle; igneous rock-origin, forms, structures and classification; Sedimentary rock – process of formation, classification, texture -concept of grain size and shape, common primary structures; Metamorphic rocks- Agents and types of metamorphism, structures and classification.	15 hrs.
UNIT-II	Definition and types of deformation in rocks; planer and linear structures; attitudes of planer and linear structures - its measurements and related symbols; Basic understanding of folds, faults, joints and unconformity; Basic Geological tools – hammer, clinometer, Brunton compass and topographical maps; Working principle of GPS.	15 hrs.
UNIT-III	Definition and importance of stratigraphy in geology; Geological time scale; Brief idea about stratotypes; imperfection of geological records; Principles of Stratigraphy; Stratigraphic units - Lithostratigraphy, biostratigraphy and chronostratigraphy.	15 hrs.
UNIT-IV	Paleontology - Fossils Definition; Preservations of fossils (nature of hard parts, modes of preservation) occurrences of Fossils; Types of Fossils – Body fossil - Mega and Micro Fossils; Living Fossils; Resin Fossils; Pseudo-fossils; derived and transported fossils; Trace Fossils; Concept of index fossils; Utility of Fossils.	15 hrs.

REFERENCES

1) Tyrrell, G. W. (2012). The principles of petrology: an introduction to the science of rocks. Springer Science & Business Media.
2) Sengupta, S. (2017). Introduction to sedimentology. Routledge.
3) Billings, M. P. Structural Geology, Prentice Hall, 1977
4) Mathur, S. M. (2001). Guide to Field Geology. PHI Learning Pvt. Ltd.
5) Weller, M.J. Stratigraphic principles and practice
6) International Commission on Stratigraphy https://stratigraphy.org/
7) An Introduction to Palaeontology, Amal Dasgupta, The World Press Private Limited
8) Black, R. M. (1999) Elements of Palaeontology, Cambridge University Press
9) Palaeontology evolution and animal distribution, P.C. Jain.

	The Maharaja Sayajirao University of Baroda **Faculty of Science** **Department of Geology** Sayajigunj, Vadodara, 390002,	ACADEMIC YEAR 2023-2024

B.Sc. (Geology): Regular Programme

YEAR	I	**Minor** **SEC2162C Rock Science Lab (SEC)**	CREDIT	2
Semester	II		HOURS	60

OBJECTIVES:	The objective of this course is to provide training to the students to identify and describe various types of rocks.

COURSE CONTENT / SYLLABUS

UNIT-I	Megascopic studies of common igneous, sedimentary and metamorphic rocks.	60 hrs.

	The Maharaja Sayajirao University of Baroda **Faculty of Science** **Department of Geology** **Sayajigunj, Vadodara, 390002,**	ACADEMIC YEAR 2023-2024

B.Sc. (Geology): Regular Programme

YEAR	I	**Multidisciplinary Course (MDC-II)**	CREDIT	4
Semester	II	**MDC2222C Geospatial Technology**	HOURS	75

OBJECTIVES:	The objective of this course is to provide the students knowledge of geospatial technology and use of remote sensing data.

COURSE CONTENT / SYLLABUS

UNIT-I	Introduction, purpose and importance of geospatial technology; Maps-importance, scale, types, elements, indexing, coordinate system, interpretation; GPS-Overview, function, segments and application.	15 hrs.
UNIT-II	Concept of remote sensing, EM-spectrum, energy sources and radiation principles, energy interaction in the atmosphere, energy interactions with earth surface features, spectral reflectance curve of vegetation, soil and water, spectral response patterns, data acquisition and interpretation, ideal and real remote sensing system. Applications of remote-sensing.	15 hrs.
UNIT-III	Development of important Indian Space Programmes	15 hrs.
UNIT-IV	Study of SOI maps, satellite imageries and GPS data (Lab).	30 hrs.

REFERENCES

1) T. M. Lillesand and P. W. Kiefer, 2016, Remote Sensing and Image Interpretation. Wiley
2) V Emayavaramban, K Kannadasan, S Vinothkanna; Geospatial Technology: Fundamentals & Applications: Fundamentals & Applications; New India Publishing Agency
3) Bradley Shellito Introduction to Geospatial Technologies W.H. Freeman & Company
4) Bhatta, B. (2008). Remote sensing and GIS.

	The Maharaja Sayajirao University of Baroda **Faculty of Science** **Department of Geology**	ACADEMIC YEAR 2024-25

B.Sc. Geology: Regular (NEP 2020)

YEAR	II	**Major Paper I:**	CREDIT	4
Semester	I	**GLM 2003C Crystallography**	HOURS	60

OBJECTIVES:	This course explores crystal morphology, symmetry, 32 point groups, laws, polymorphism, defects, crystal chemistry (Pauling's rules, radius ratio), and X-ray crystallography. Practicals: models, projections, calculations.

COURSE CONTENT / SYLLABUS

UNIT-I	**Theory** Crystal morphology (symmetry, axis, forms, zones and habit), Measurement of crystal angles, Crystallographic laws (law of constancy of interfacial angles, the law of rationality of indices, the law of symmetry), Symmetry elements and operations, Crystallographic projections, 32-point groups of six crystal systems.	15 hrs.
UNIT-II	**Theory** Iso-structuralism, Polymorphism, Polytypism, Metamict Minerals, Mineraloids, Pseudomorphism, Crystal defects, Intergrowths of crystals-parallel growth, epitaxies, twinning and common twin laws.	15 hrs.
UNIT-III	**Theory** Introduction to crystal chemistry- Ionic and atomic radii, packing, radius ratio and coordination number, chemical bonds, Pauling's rules. Introduction to X-ray crystallography-X-ray spectra, diffraction effects and Bragg's equation.	15 hrs.
UNIT-IV	**Practical** Crystal models of 32-point groups, stereographic projections, numerical problems related to radius ratio and coordination number.	15 hrs.

REFERENCES

1. Cornelius K, and Cornelius S. H. (1895) Manual of Mineralogy John Wiley & Sons.
2. Read, H. H. (1966) Rutley's Elements of Mineralogy 26th Edition, S. K. Jain and CBS Publishers and distributors. P.560.
3. Sands, D.E. 1975. An Introduction to Crystallography, W. A. Benjamine Inc., New York.

	The Maharaja Sayajirao University of Baroda **Faculty of Science** **Department of Geology**	ACADEMIC YEAR 2024-25

B.Sc. Geology: Regular (NEP 2020)

YEAR	II	**Major Paper II:**	CREDIT	4
Semester	I	**GLM 2013C Mineralogy**	HOURS	60

OBJECTIVES:	This course examines silicate minerals (Neso- to Tecto-), compositional variations, non-silicates (carbonates to phosphates), and Goldschmidt classification. It covers optical mineralogy: polarized light, petrological microscope, refractive index, birefringence, and accessories. Practicals: thin-section mineral studies.

COURSE CONTENT / SYLLABUS

UNIT-I	**Theory** Compositional variations in minerals-solid solution, exsolution, Systematic Study of Neso-, Soro-, Cyclo-, Ino-silicate minerals with reference to their chemical formula, structure, classification and occurrences.	15 hrs.
UNIT-II	**Theory** Systematic Study of Phyllo- and Tecto-silicate minerals with reference to their chemical formula, structure, classification and occurrences. Carbonates, Oxides, Halides, Sulphates, Sulphides and Phosphates Groups, Goldschmidt classification of elements.	15 hrs.
UNIT-III	**Theory** Elements of optics – ordinary and polarized light, Petrological microscope, isotropic and anisotropic substances, Snell's law, critical angle and total internal reflection, refractive index and Becke's line, dichroism and pleochroism, interference of light, Michel-Levy chart, optical accessories, extinction and birefringence.	15 hrs.
UNIT-IV	**Practical** Study of various rock forming minerals in thin sections.	15 hrs.

REFERENCES

1. Hurlbut, C. S., & Klein, C. (1977). Manual of mineralogy (after James D. Dana). Wiley.
2. Perkins, D. (1998). Mineralogy. Begin, 17, 17-38.
3. Rutley, F. (2012). Rutley's elements of mineralogy. Springer Science & Business Media.

	The Maharaja Sayajirao University of Baroda **Faculty of Science** **Department of Geology**	ACADEMIC YEAR 2024-25

B.Sc. Geology: Regular (NEP 2020)

YEAR	II	**Major Paper III:**	CREDIT	4
Semester	I	**GLM 2023C Geomorphology**	HOURS	60

OBJECTIVES:	This course covers morphogenetic landforms, drainage patterns, Davisian erosion cycle, geomorphic processes (fluvial, coastal, aeolian), karst, glaciers, and planetary geomorphology. Practicals: topographic map interpretation, cross-profiles, landform extraction.

COURSE CONTENT / SYLLABUS

UNIT-I	**Theory** Concept of morphogenetic landforms, geomorphic features in areas comprising horizontal, dipping, folded and faulted rocks, Types of drainage patterns and their geological significance, Davisian model of cycle of erosion and fluvial cycle, Valley profiles, Base level and classification of valleys, Concept of graded stream.	15 hrs.
UNIT-II	**Theory** Geomorphic processes involved in development of erosional and depositional landforms of fluvial, coastal and aeolian systems.	15 hrs.
UNIT-III	**Theory** Karst topography – essential conditions to development of karst, important karst regions, features characteristics of karst region and karst geomorphic cycle. Glaciers-formation of ice, their classification, modern day distribution, nourishment and wastage, movement, erosional and depositional landforms (stratified and unstratified drifts). Introduction to planetary geomorphology.	15 hrs.
UNIT-IV	**Practical** Topographic map- interpretation, preparation of a cross profile, extraction of landforms of fluvial, coastal, aeolian and glacial origin.	15 hrs.

REFERENCES

1	Bloom A. L. Geomorphology: A Systematic analysis of late Cenozoic landforms. (3rd Ed.)
2	Thornbury, W.D. Principles of geomorphology. CBS Pub. Delhi
3	Leet, L.D. & Judson, S. (1969) Physical Geology

	The Maharaja Sayajirao University of Baroda **Faculty of Science** **Department of Geology**	ACADEMIC YEAR 2024-25

B.Sc. Geology: Regular (NEP 2020)

YEAR	II	**MDC Paper I:**	CREDIT	4
Semester	I	**MDC 2533C Earth Surface Processes**	HOURS	60

OBJECTIVES:	This course introduces geomorphology, surface processes (endogenous, exogenous), weathering, soil profiles, drainage patterns, landforms (fluvial, aeolian, glacial, volcanic, oceanic, karst), and applied geomorphology. Practicals: toposheet profiles, landform studies.

COURSE CONTENT / SYLLABUS

UNIT-I	**Theory** Concepts of geomorphology, introduction to earth surface processes- endogenous, exogenous and extra-terrestrial processes; Weathering-Mechanical, chemical and biological; development of soil, soil profile.	15 hrs.
UNIT-II	**Theory** Drainage patterns; processes and landforms associated with fluvial and aeolian systems and glacial systems; volcanic landforms.	15 hrs.
UNIT-III	**Theory** Processes and landforms associated with oceans. Karst Topography-Conditions for the development of karst features, sinkhole and associated features. Introduction to applied geomorphology.	15 hrs.
UNIT-IV	**Practical** Topographic maps, concept of scale, preparation of a topographic profile, study of various landforms on SOI toposheets.	15 hrs.

REFERENCES

1	Bloom A. L. Geomorphology: A Systematic analysis of late Cenozoic landforms. (3rd Ed.)
2	Thornbury, W.D. Principles of geomorphology. CBS Pub. Delhi
3	Leet, L.D. & Judson, S. (1969) Physical Geology

	The Maharaja Sayajirao University of Baroda **Faculty of Science** **Department of Geology**	ACADEMIC YEAR 2024-25

B.Sc. Geology: Regular (NEP 2020)

YEAR	II	**SEC:**	CREDIT	2
Semester	I	**SEC2443 Interpretation of Satellite Data and its Applications (Lab)**	HOURS	30

OBJECTIVES:	This lab course introduces remote sensing platforms, satellites, sensor types, and resolutions (spatial, spectral, radiometric, temporal), plus data products. Exercises focus on satellite image interpretation for geomorphic/structural features, land cover, and temporal change analysis in vegetation/parameters.

COURSE CONTENT / SYLLABUS

UNIT-I	**Lab** Remote Sensing Platforms, Satellites and orbits, types of sensors. Resolutions: spatial, spectral, radiometric, temporal resolutions. Types of data products.	15 hrs.
UNIT-II	**Lab** Exercises on satellite image interpretation for identification of common geomorphic and structural features, land cover types and other relevant information. Temporal analysis of satellite images for analyzing and interpreting changes in land cover, vegetation and other relevant parameters.	15 hrs.

REFERENCES

1	Conway, E. D. (1997). An introduction to satellite image interpretation. JHU Press.
2	A. A. Misra (Editor), S. Mukherjee (Editor) - Atlas of Structural Geological and Geomorphological Interpretation of Remote Sensing Images, John-Wiley.

	The Maharaja Sayajirao University of Baroda **Faculty of Science** **Department of Geology**	ACADEMIC YEAR 2024-25

B.Sc. Geology: Regular (NEP 2020)

YEAR	II	**IKS:**	CREDIT	2
Semester	I	**IKS2343C Geological Making of India: A Rigvedic Perspective**	HOURS	30

OBJECTIVES:	This course explores India's geological formation from a Rigvedic perspective, covering the Rigvedic period, Sapta-sindhu region, geological and Rigvedic evidences, land/river/mineral descriptions, and Deccan overview in ancient texts.

COURSE CONTENT / SYLLABUS

UNIT-I	**Theory** Brief introduction to rigvedic period, Introduction to Sapta-sindhu, Geological evidences of Sapta-sindhu, Rigvedic evidences supporting geological evidences of Sapta-sindhu.	15 hrs.
UNIT-II	**Theory** Description of land and rivers of Sapta-sindhu and its minerals from rigveda. Overview of deccan or southern india in rigvedic times.	15 hrs.

REFERENCES

1	Das, A. C. (1927). Ṛigvedic India (Vol. 1). R. Cambray.
2	Y.S. Sahasrabuddhe (2006) Geology in ancient vedic literature.

	The Maharaja Sayajirao University of Baroda **Faculty of Science** **Department of Geology**	ACADEMIC YEAR 2024-25

B.Sc. Geology: Regular (NEP 2020)

YEAR	II	**Major Paper I:**	CREDIT	4
Semester	II	**GLM 2004C Igneous petrology**	HOURS	60

OBJECTIVES:	To understand magma properties, igneous rock forms, textures, and classifications (CIPW, IUGS, TAS). It covers phase equilibria in silicate systems, chemical petrology, magmatic processes (differentiation, assimilation), and tectono-magmatic environments. Practicals include microscopic igneous rock studies and field exercises.

COURSE CONTENT / SYLLABUS

UNIT-I	**Theory** Origin and types; Physical properties of magma (temperature, viscosity, density and volatile content) and chemical composition; Intrusive and extrusive forms; structure and textures of igneous rocks and its petrogenetic significance; Classification of igneous rocks- based on mode of occurrence, chemical and mineralogical composition, IUGS classification (QAPF, mafic and ultramafic triangles); chemical classification schemes (TAS diagram).	15 hrs.
UNIT-II	**Theory** Phase equilibria in igneous systems- Introduction (The phase rule and lever rule), phase equilibrium in one-component (SiO_2), two components (diopside-anorthite, forsterite-silica, albite-anorthite and albite-orthoclase), three component (diopside – albite – anorthite, forsterite – diopside – silica) silicate systems and their petrogenetic significance. Introduction to chemical petrology (Major and minor elements, Goldschmidt's classification, variation diagrams based on major elements in igneous rocks).	15 hrs.
UNIT-III	**Theory** Magmatic processes- Differentiation (gravity settling, filter pressing, flow segregation), mixing, assimilation and magma diversity; Tectono-magmatic environments and magma series- Intraplate and interplate volcanism and associated magmatism; Petrogenesis of common felsic and mafic igneous rocks.	15 hrs.
UNIT-IV	**Practical** Microscopic studies of important igneous rocks. Outdoor practical exercise in igneous terrain.	15 hrs.

REFERENCES

1	Winter, J. D. (2014). Principles of igneous and metamorphic petrology. Pearson.
2	Philpotts, A., & Ague, J. (2009). Principles of igneous and metamorphic petrology. Cambridge University Press.
3	Bose M.K. (1997). Igneous Petrology.
4	White, W. M. (2020). Geochemistry. John Wiley & Sons.

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B.Sc. Geology: Regular (NEP 2020)

YEAR	II	**Major Paper II:**	CREDIT	4
Semester	II	**GLM2014C Sedimentary petrology**	HOURS	60

OBJECTIVES:	This course covers weathering, fluid dynamics, duricrusts, sediment texture/structures, siliciclastics, carbonates, diagenesis, facies, and depositional environments. It examines classification, provenance, dolomitization, and sedimentary processes. Practicals include microscopic rock studies and sedimentary field exercises.

COURSE CONTENT / SYLLABUS

UNIT-I	**Theory** Role of weathering in sedimentation: a) Surface processes of rock weathering b) Chemistry of the weathering processes and mobility of oxides; Fluid dynamics: laminar and turbulent flow, Reynold's number, Froude number, boundary layers, particle entrainment, liquefied flow, grain flow, debris and mud flow, turbidity current; Introduction and types of duricrust: Calcrete, Silcrete, Ferricrete.	15 hrs.
UNIT-II	**Theory** Concept of grain size and texture of sediments; Primary sedimentary structures: Stratification and bedforms, bedding plane markings; Secondary sedimentary structures: erosional structures; chemical and organic sedimentary structures; Introduction to soft-sediment deformation structures and seismites; Siliciclastics: Classification and detailed petrographic study of conglomerate, sandstone, shale, and mud rocks. An introduction to provenance analysis.	15 hrs.
UNIT-III	**Theory** Carbonate rocks: Constituents of carbonate rocks: skeletal, non-skeletal, allochemical and orthochemical components. Major controls on carbonate sedimentation and classification of limestones. Dolomitization and dedolimitization. Introduction to other chemical, biochemical and carbonaceous sedimentary rocks (Evaporites, cherts, ironstones, phosphorites and coal). Basic concepts and stages of diagenesis. Concept of sedimentary facies and Walther's law. Introduction to continental and marine depositional environments.	15 hrs.
UNIT-IV	**Practical** Microscopic studies of clastic and non-clastic sedimentary rocks. Outdoor practical exercise in sedimentary terrain.	15 hrs.

REFERENCES

1. Nichols, G., 2009. Sedimentology and stratigraphy. John Wiley & Sons.
2. Boggs, S., 2009. Petrology of sedimentary rocks. Cambridge university press.
3. Sengupta, S. M., 2007. Introduction to sedimentology. Second edition. CBS Publishers and Distributors Pvt. Ltd.
4. Tucker, M.E. and Wright, V.P., 2009. Carbonate sedimentology. John Wiley & Sons.

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B.Sc. Geology: Regular (NEP 2020)

YEAR	II	**Major Paper III:**	CREDIT	4
Semester	II	**GLM 2024C Metamorphic Petrology**	HOURS	60

OBJECTIVES:	To understand types of metamorphism, controlling factors, structures, mineral reactions, and rock classification. It covers regional/contact metamorphism of key rock types, facies series, Barrovian zones, metasomatism, fluids, migmatites, and plate tectonics links. Practicals include microscopic studies and metamorphic field exercises.

COURSE CONTENT / SYLLABUS

UNIT-I	**Theory** Metamorphism; limits of metamorphism; factors controlling metamorphism, types of metamorphism-contact, regional, hydrothermal, fault-zone and impact metamorphism; genesis of micro-scale and mesoscale structures; relationship between metamorphism and deformation; metamorphic mineral reactions; classification of metamorphic rocks.	15 hrs.
UNIT-II	**Theory** Regional and contact metamorphism of argillaceous, calcareous, quartzo-feldspathic and basic igneous rocks; concept and classification of metamorphic facies; metamorphic facies series; Barrovian zones and isograds.	15 hrs.
UNIT-III	**Theory** Metasomatism and role of fluids in metamorphism; origin and structure of migmatites and amphibolites; metamorphism and its relation to plate tectonics; paired metamorphic belts; petrogenesis of common occurring metamorphic rocks.	15 hrs.
UNIT-IV	**Practical** Microscopic studies of important metamorphic rocks. Outdoor practical exercise in metamorphic terrain.	15 hrs.

REFERENCES

1. Winter, J. D. (2014). Principles of igneous and metamorphic petrology. Pearson
2. Barker, A. J. (2013). Introduction to metamorphic textures and microstructures. Routledge.
3. Turner, F. J., & Verhoogen, J. (1960). Igneous and metamorphic petrology
4. Yardley, B., & Warren, C. (2021). An introduction to metamorphic petrology. Cambridge University Press.
5. Miyashiro Akiho. Metamorphism and metamorphic belts. George Allen & Unwin

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B.Sc. Geology: Regular (NEP 2020)

YEAR	II	**Minor Paper I:**	CREDIT	4
Semester	II	**GLE2004C Evolution of life through time**	HOURS	60

OBJECTIVES:	To understand traces life's origin, evolution theories, fossil preservation, kingdoms classification, Phanerozoic biological events, mass extinctions, and key transitions (Cambrian explosion, oxygenation, dinosaurs, hominids). It covers Precambrian to Cenozoic life forms, evolutionary patterns, and Indian Phanerozoic fossils. Practicals include fossil modes and evolutionary exercises.

COURSE CONTENT / SYLLABUS

UNIT-I	**Theory** Theories of Origin and Evolution of life, Evidences of evolution of life, Five kingdoms classification of life, Types of fossils and modes of preservation, Patterns of evolution, Major biological events through geologic time, Mass extinctions and turnover of entire ecosystems.	15 hrs.
UNIT-II	**Theory** Environment of the early Earth, the Great Oxygenation Event, the Rise of Algae, Evolution of different life forms- Bacteria, Ediacara biota and others,The Cambrian explosion, Life in various time periods of the Palaeozoic era, Rise of fishes, amphibians tetrapods and invasion of land. End Palaeozoic environmental crisis and mass extinction.	15 hrs.
UNIT-III	**Theory** Life forms of the Mesozoic era, The rise of the reptiles, Dinosaurs and birds, End Mesozoic meterorite impact and mass extinction, Life during the Tertiary and Quaternary periods, Cenozoic land bridges, sea level changes and dispersal of life, Evolutionary history of horse, camel, elephant, Primates and Hominids, Cultural evolution of man.	15 hrs.
UNIT-IV	**Lab** Study of modes of fossil preservation; Study of Phanerozoic fossils from India; Exercises related to major evolutionary trends in important groups of animals.	15 hrs.

REFERENCES

1.	Stanley, S.M. & Luczaj, J.A. (2014). Earth System History (4th Edition).
2.	Cowen, R. (2000). History of Life. Wiley-Blackwell.
3.	Benton, M.J. & Harper, D.A.T. (2016). Introduction to Paleobiology and the fossil record. Wiley.
4.	Lumine, J. I. & Freeman, W.H. (1999). Earth-Evolution of a Habitable World, Cambridge University Press.
5.	Canfield, D.E. & Konhauser, K.O., (2012). Fundamentals of Geobiology, Blackwell.

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B.Sc. Geology: Regular (NEP 2020)

YEAR	II	**VAC:**	CREDIT	2
Semester	II	**VAC2374C Medical Geology**	HOURS	30

OBJECTIVES:	To understand medical geology's history, principles, branches, and public health links, including natural disaster effects and geogenic risks from fluoride, arsenic, and uranium. It examines anthropogenic contamination from mining/urban sources, occupational diseases (silicosis, asbestosis), and geological mitigation strategies.

COURSE CONTENT / SYLLABUS

UNIT-I	**Theory** History of medical geology; Principles, branches, prospects and development of medical geology; The relation between medical geology and public health; Effects of natural disasters on human health. Medical geology of fluoride, arsenic, uranium.	15 hrs.
UNIT-II	**Theory** Anthropogenic sources of contaminating elements: mining, mineral processing and metal refining, contaminants in urban areas. Mining geology problems: Silicosis, Black Lung Disease, Asbestosis, Heavy Metal Toxicity. Mitigations of health hazards using geological knowledge.	15 hrs.

REFERENCES

1.	Dissanayake, C. B., and Chandrajith, R. (2009). Introduction to medical geology. Springer science & business media.
2.	Selinus, O. (2007). Medical geology: An opportunity for the future. AMBIO: A Journal of the Human Environment, 36(1), 114-116.
3.	Davies, B. E., Bowman, C., Davies, T. C., and Selinus, O. (2012). Medical geology: Perspectives and prospects. Essentials of medical geology: Revised edition, 1-13.
4.	Gomes, C.D.S.F. and Silva, J.B.P., 2007. Minerals and clay minerals in medical geology. Applied Clay Science, 36(1-3), pp.4-21.

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B.Sc. Geology: Regular (NEP 2020)

YEAR	II	**SEC:**	CREDIT	2
Semester	II	**SEC2434C GPS and Geocaching**	HOURS	30

OBJECTIVES:	This course introduces GPS fundamentals: system overview, geocaching, geotagging, receivers, satellite constellations, segments, antennas, signal codes, errors, and accuracy. It emphasizes practical GPS applications through hands-on training, field exercises, and individual projects.

COURSE CONTENT / SYLLABUS

UNIT-I	**Theory** Overview of Global Positioning System, Geocaching and Geotagging, GPS Receivers, Satellite Constellations, Segments, Antennas, Signal Codes and errors; Accuracy of GPS measurements.	15 hrs.
UNIT-II	**Theory** Application of GPS, Hands on training, field training and individual projects using GPS.	15 hrs.

REFERENCES

1.	Rahman Atiqur, Fazal Shahab Global Positioning System: Concept, Technique and Application, New Age International(P) ltd.,Publishers
2.	Satheesh Gopi, Global Positioning System: Principles and Applications, Tata Mcgraw-Hill Publishing Company Limited, 2005

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B.Sc. Geology: Regular (NEP 2020)

YEAR	III	**Major Paper I:**	CREDIT	4
Semester	I	**GLM 3005C Structural Geology**	HOURS	60

OBJECTIVES:	To understand and apply the principles of structural geology, including kinematic and dynamic analyses, types of stress and strain, and the interpretation of rock structures like folds, faults, and joints.

COURSE CONTENT / SYLLABUS

UNIT-I	**Theory** Descriptive, kinematic and dynamic analyses; penetrative and non-penetrative structures, scale and symmetry of structures, tectonites; Types of stress and strain, stress at a point, stress matrix, Mohr circle of stress, strain markers, Flinn and Ramsay diagrams; Types of planar and linear structures and their utility in structural analyses; Rock cleavages - types and geometrical relations with folds.	15 hrs.
UNIT-II	**Theory** Folds – structural elements of folds, qualitative description of folds, morphological classification (Ramsay classification) of folds, outcrop patterns; Mechanisms of folding, Interfering folds; Unconformities – types, basement cover relationship.	15 hrs.
UNIT-III	**Theory** Faults – terminology and classification; Anderson theory of faulting, effects of faulting on topography and outcrops, criteria for identification of faults; Joints – types and geometrical relation with folds and faults; Introduction to deformation bands.	15 hrs.
UNIT-IV	**Practical** Geological Maps – study of outcrop patterns; Interpretation and construction of cross- sections. Three-point problems, stereographic and orthographic projections.	15 hrs.

REFERENCES

1.	Ghosh, S. K. (2013). Structural geology: Fundamentals and modern developments. Elsevier.
2.	Billings, M. P. (1972). Structural geology. Prentice Hall of India Pvt. Ltd.
3.	Fossen, H. (2016). Structural geology. Cambridge university press.
4.	Davis, G. H., Reynolds, S. J., & Kluth, C. F. (2011). Structural geology of rocks and regions. John Wiley and Sons.
5.	Ramsay J. G. (1967), Folding and fracturing of Rocks, McGraw Hill Pub.
6.	Ramsay J.G. and Huber M. I., (1983). The Techniques of Modern Structural Geology, Strain Analysis, Academic Press.
7.	G.W.Chiplonkar (1962) Geological Maps. Dastane Ramchandra & Co. Pune.
8.	Marshak, S., & Mitra, G. (1988). Basic methods of structural geology.

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B.Sc. Geology: Regular (NEP 2020)

YEAR	III	**Major Paper II:**	CREDIT	4
Semester	I	**GLM 3015C Paleontology**	HOURS	60

OBJECTIVES:	To understand the theories of life's origin, mechanisms of evolution, and the factors influencing faunal distribution, along with the classification and geological distribution of various plant and animal groups.

COURSE CONTENT / SYLLABUS

UNIT-I	**Theory** Theories of origin of life; Mechanism and patterns of evolution; Factors affecting faunal distribution and dispersal; Causes of Mass Extinction; Classification of organisms and taxonomic hierarchy; Morphology and geological distribution of vascular and nonvascular plants.	15 hrs.
UNIT-II	**Theory** Morphology, classification and geological distribution of Trilobita, Graptolites and Brachiopoda, Mollusca (Bivalvia, Gastropoda, and Cephalopoda), Echinoidea and Cnidaria; Morphology and geological distribution of fish, amphibians, reptiles, birds, and mammals, Extinction of dinosaurs; Human evolution.	15 hrs.
UNIT-III	**Practical** Study of Modes of preservation of fossils; Morphology and geological history of invertebrate fossil groups (Brachiopoda, Mollusca)	15 hrs.
UNIT-IV	**Practical** Morphology and geological history of invertebrate fossil groups (Trilobita, Graptolite, Echinoidea and Cnidaria); Important Plant and vertebrate fossils.	15 hrs.

REFERENCES

1. Black, R. M. (1999) Elements of Palaeontology, Cambridge University Press.
2. Clarkson E. N. K (1986) Invertebrate paleontology and evolution. Allen & Unwin, London
3. Jain P. C. and M.S. Anantharaman (2017) An Introduction to Palaeontology. Evolution and Animal Distribution. Vishal Publishing Company, Jalandhar-Delhi
4. Wood, H. (1961) Invertebrate Palaeontology. International Book Bureau Hyderabad.
5. Shrock R. R. and Twenhofel W. H. (1987) Principles of Invertebrate Palaeontology CBS Publishers and Distributors.
6. Jain, S. (2020). *Fundamentals of Invertebrate Palaeontology*. Springer India.

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B.Sc. Geology: Regular (NEP 2020)

YEAR	III	**Major Paper III:**	CREDIT	4
Semester	I	**GLM 3025C Remote Sensing and GIS**	HOURS	60

OBJECTIVES:	To understand the principles of photogeology, remote sensing, and GIS, including energy interactions, data acquisition, image interpretation, and applications in Earth sciences.

COURSE CONTENT / SYLLABUS

UNIT-I	**Theory** Photogeology; Aerial photographs-Types and Geometry, Normal vision and depth perception, Stereoscopic vision - vertical exaggeration and factors affecting vertical exaggeration; Concept of remote sensing, EM-spectrum, energy sources and radiation principles; energy interaction in the atmosphere (atmospheric effects in remote sensing); energy interactions with earth surface features; spectral reflectance curve of vegetation, soil and water; spectral response patterns; data acquisition and image interpretation; ideal and real remote sensing system.	15 hrs.
UNIT-II	**Theory** Applications of remote-sensing in earth sciences; Introduction to GIS-Types of GIS; Geographical data representation – discrete and continuous data; GIS data models – raster, vector, attributes; Introduction to projections systems, spatial analysis – vector and raster- based analysis; Introduction to Digital Elevation Model (DEM).	15 hrs.
UNIT-III	**Practical** Marginal information of satellite data, Identification of tone and texture from satellite data, visual image interpretation of satellite data with reference to structural geological and geomorphological features.	15 hrs.
UNIT-IV	**Practical** Preparation of land use and land cover, lineament and hydro geomorphological maps using satellite data and exercises on google earth.	15 hrs.

REFERENCES

1.	Leuder, D. R. Aerial photographic interpretation: Principles and Interpretation.
2.	Lillesand, T., Kiefer, R. W., & Chipman, J. (2015). Remote sensing and image interpretation. John Wiley & Sons.
3.	Curran, P. J. (1988) Principles of remote sensing.
4.	Miller, V.C. & Miller, C.F. Photogeology. McGraw Hill Pub. New York.
5.	Gupta, R. P. (2017). Remote sensing geology. Springer.
6.	Bhatta, B. (2008). Remote sensing and GIS (Vol. 2). New Delhi: Oxford University Press.
7.	Misra, A. A., & Mukherjee, S. (Eds.). (2022). Atlas of Structural Geological and Geomorphological Interpretation of Remote Sensing Images. John Wiley & Sons.

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B.Sc. Geology: Regular (NEP 2020)

YEAR	III	**Minor Paper I:**	CREDIT	4
Semester	I	**GLE 3005C Stratigraphy and Precambrian geology of India**	HOURS	60

OBJECTIVES:	To study the geological evolution of the Earth during the Precambrian, including crustal evolution, glaciations, and tectonic subdivisions of India, focusing on the structural and stratigraphic framework of major Indian cratons and sedimentary basins.

COURSE CONTENT / SYLLABUS

UNIT-I	**Theory** Stratigraphic correlation based on physical and paleontological evidences; Vertical succession, lateral variation and facies concept; Graphic representation of stratigraphic data; Stratigraphic maps; International code of stratigraphic nomenclature of lithostratigraphy, biostratigraphy, chronostratigraphy and magnetostratigraphy; Stratotypes-types and guidelines for designating Stratotypes [Global Stratotype Section and Point (GSSP)]; GSSP of Precambrian-Cambrian boundary.	15 hrs.
UNIT-II	**Theory** Divisions of Precambrian supereon; Geological evolution of the earth during Precambrian - crustal evolution, oxygen catastrophe and BIF; Neoproterozoic glaciations and snowball earth hypothesis; Archean and Proterozoic life; Physiography, drainage and tectonic subdivisions of Indian subcontinent; Structure, tectonics and Precambrian stratigraphy of the Himalayas; Structure and tectonics of the Peninsular India- Cratons, shields, platforms, mobile belts and shear zones.	15 hrs.
UNIT-III	**Theory** Structural framework, stratigraphy, and geological evolution of Aravalli-Delhi fold belt, Southern Aravalli Mountain belt, Dharwar craton, Southern Granulite Terrane, Singhbhum Craton, Eastern Ghats Mobile Belt, Bastar Craton and Bundelkhand Craton.	15 hrs.
UNIT-IV	**Theory** Structural framework, stratigraphy, and geological evolution of Proterozoic sedimentary basins of India- Vindhyan, Cuddapah, Chhattisgarh, Kaladgi, Pakhal and Bhima basins; Economical importance of Precambrian formations.	15 hrs.

REFERENCES

1.	Ramakrishnan, M., & Vaidyanadhan, R. (2008). Geology of India (Vol 1 and 2), Geological Society of India.
2.	Valdiya, K. S. (2010) The making of India, Macmillan India Pvt. Ltd
3.	Sharma, R. (2009). Cratons and fold belts of India (Vol. 127). Springer.
4.	Wadia, D. N.(1978) Geology of India, Tata McGraw Hill.
5.	Krishnan, M. S. (1982) Geology of India and Burma, CBS Publishers, Delhi
6.	Weller J. M. (1960) Stratigraphic Principles and Practice, UBS Publications.
7.	Salvador, A. (Ed.). (1994). International stratigraphic guide: a guide to stratigraphic classification, terminology, and procedure (No. 30). Geological Society of America.
8.	Doyle, P., & Bennett, M. R. (Eds.). (1998). Unlocking the stratigraphical record: advances in modern stratigraphy. John Wiley & Sons
9.	https://stratigraphy.org

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YEAR	III	**Minor Paper II:**	CREDIT	4
Semester	I	**GLE 3015C Global Tectonics**	HOURS	60

OBJECTIVES:	To explore the dynamics of plate tectonics, including plate motions, divergent, convergent, and transform boundaries, orogenic belts, and the tectonic history of the Indian plate, with an understanding of hotspots, mantle convection, and supercontinent cycles.

COURSE CONTENT / SYLLABUS

UNIT-I	**Theory** Origin of the planetary system; Seismic waves; Composition of the earth; Lithosphere and asthenosphere; Gravity anomalies; Earth's magnetic field and paleomagnetism; Continental drift and seafloor spreading theories and their evidences; Concept of geosyncline.	15 hrs.
UNIT-II	**Theory** Introduction to plate tectonics- Macro and micro plates, distribution of plates; Plate motions- relative and absolute methods; Divergent Plate Boundaries- Mid Oceanic ridges (morphology and spreading rate, petrology of MOR, origin of oceanic crust); Continental rifts (characteristic, structure and origin).	15 hrs.
UNIT-III	**Theory** Convergent plate boundary- trenches, accretionary prism, volcanic and island arcs; Transform Boundary- Transform and transcurrent faults; Orogenic belts- Ocean-continent convergence, continent-continent collision and arc-continent collision; Forces acting on plates.	15 hrs.
UNIT-IV	**Theory** Concept of hotspot and triple junction; Mantle convection and plumes; Precambrian and phanerozoic supercontinents and supercontinent cycles; Tectonic history of the Indian plate.	15 hrs.

REFERENCES

1. Kearey, P., Klepeis, K. A., & Vine, F. J. (2009). Global tectonics. John Wiley & Sons. Oxford
2. Condie, K. C. (2013). Plate tectonics & crustal evolution. Elsevier.
3. Cox, A., & Hart, R. B. (1991). Plate tectonics: How it works. John Wiley & Sons.
4. Le Pichon, X., Francheteau, J., & Bonnin, J. (2013). Plate tectonics (Vol. 6). Elsevier
5. Fossen, H., & Teyssier, C. (2024). Plate Tectonics. Cambridge: Cambridge University Press

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B.Sc. Geology: Regular (NEP 2020)

YEAR	III	**SEC:**	CREDIT	2
Semester	I	**SEC3625C Field Geology**	HOURS	30

OBJECTIVES:	To develop skills in planning and executing a geological field project, including literature review, map interpretation, field equipment usage, geological mapping, and field documentation, while ensuring safety and producing a technical report.

COURSE CONTENT / SYLLABUS

UNIT-I	**Theory** Planning of field project – Literature review, topographical maps, and geological maps; Essential field equipments – Brunton compass and clinometer, geological hammers; Overview and principle/working/functioning of GPS; Concept of true thickness and vertical thickness; Determination of top & bottom of beds	15 hrs.
UNIT-II	**Theory** Basic concepts of geological mapping in igneous, sedimentary, and metamorphic terrains; Sampling methods; Field documentation – field diary, sketches, logs, block diagrams, photographs; Measuring and recording attributes of various planar and linear features; Safety in geological fieldwork; Writing of technical report; Outdoor practical in various geological terrains.	15 hrs.

REFERENCES

1. Mathur, S. M. (2001). Guide to Field Geology. PHI Learning Pvt. Ltd.
2. N. W. Gokhale, (2001). A Guide to Field Geology, CBS Publishers.
3. Compton, R. R., & Compton, R. R. (1985). Geology in the Field. New York: Wiley.
4. McCann, T. (2021). Pocket Guide Geology in the Field. Springer.
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B.Sc. Geology: Regular (NEP 2020)

YEAR	III	**Major Paper I:**	CREDIT	4
Semester	II	**GLM3006C Groundwater and Engineering Geology**	HOURS	60

OBJECTIVES:	To understand the key concepts of groundwater, including aquifer properties, recharge, flow dynamics, and pollution, as well as to apply engineering principles in geological investigations for construction materials, environmental impact assessments, and groundwater modelling.

COURSE CONTENT / SYLLABUS

UNIT-I	**Theory** Aquifer and its properties – Porosity, Permeability, Transmissivity, Specific Yield, Specific retention and Storativity; Hydraulic conductivity; Isotropy and homogeneity of aquifers; Darcy's law; Groundwater potential and hydraulic head; Concept of groundwater flow direction - water table and potentiometric surface maps; Springs and its classification; Influent and effluent streams.	15 hrs.
UNIT-II	**Theory** Concept of groundwater recharge - direct and indirect methods; Methods of groundwater investigation; Groundwater quality criteria; Groundwater pollution; Concept of seawater intrusion-prevention and control.	15 hrs.
UNIT-III	**Theory** Soils as foundation and construction material; Engineering properties of rocks; Rock mass classification BGD and RQD; Engineering properties of soils and unified soil classification; Geological consideration in the construction of dams, tunnels, roads and bridges; Environmental Impact Assessment of Engineering projects.	15 hrs.
UNIT-IV	**Practical** Exercises on estimation of rainfall through various methods, groundwater flow, hydrogeological cross-sections, hydrochemical data representation; Numerical problems on porosity, permeability, specific yield, storativity, pore velocity, Reynold's number, hydraulic gradient, Darcy's law. Basic numerical groundwater modelling.	15 hrs.

REFERENCES

1.	Attewell P B and Farmer J W (1976) Principles of engineering Geology; Chapman & Hall.
2.	Bell F G (1983) Fundamentals of engineering geology; Butterworths, London.
3.	Davis, S N and Dewiert R J M (1974) Hydrogeology, John Wiley & sons.
4.	Farmer, I. W. (1968) Engineering properties of rocks; E & EN Spon-ltd.
5.	Karanth. K. R. (1989) Introduction to Hydrogeology. McGraw Hills Book Co. New Delhi.
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YEAR	III	**Major Paper II:**	CREDIT	4
Semester	II	**GLM3016C Ore Genesis and Economic Geology**	HOURS	60

OBJECTIVES:	To explore the formation, classification, and distribution of ore deposits, with an emphasis on their genesis, controls, and relation to plate tectonics, and to develop skills in the study of ore minerals and reserve estimation in India.

COURSE CONTENT / SYLLABUS

UNIT-I	**Theory** Ores and gangue minerals; Structure and texture of ore deposits, concordant and discordant ore bodies; Metallogenic provinces and epochs; Controls of mineral localization; Ore deposits in relation to plate tectonics; Fluid inclusions in ore.	15 hrs.
UNIT-II	**Theory** Processes of formation of mineral deposits- Magmatic concentration, sublimation, contact metasomatism, hydrothermal, sedimentation, oxidation and supergene enrichment, volcanogenic massive sulphides, evaporation, residual and mechanical concentration, and metamorphism.	15 hrs.
UNIT-III	**Theory** Genesis and distribution of ore minerals in India - Precious (Gold, Silver, Platinum), Metallic (Iron, Manganese, Chromium, Copper, Lead, Zinc, Aluminum, Magnesium, Tin, Tungsten), Non-metallic (Diamond and Gemstones), Radioactive (Uranium and Thorium) and important rare earth mineral resources; Occurrence and distribution of beach and placer deposits, coal and petroleum, ceramic, refractory, and fertilizer minerals.	15 hrs.
UNIT-IV	**Practical** Megascopic and microscopic study of Metallic and non-metallic ore minerals. Exercises on assessment of ore grade and reserve estimation.	15 hrs.

REFERENCES

1.	Cuilbert, J.M. and Park,Jr. C.F.(1986): The Geology of Ore Deposits, Freidman
2.	Laurence Robb. Introduction to Ore-Forming Processes.: Blackwell Publishing.
3.	Evans, A.M. (1993): Ore Geology and Industrial Minerals, Blackwell Publishing.
4.	Vaughan, D. J., & Craig, J. R. (1994). Ore microscopy and ore petrography. John Wiley & Sons Ltd.
5.	Klemm, D.D. and Schnieder, H.J. (1977): Time and Strata Bound Ore Deposits, Springer- Verlag.
6.	Mookherjee, A. (2000): Ore Genesis-A Holistic Approach, Allied Publisher.
7.	Ramdhor, P. (1969): The Ore Minerals and their Intergowths, Pergamon Press.
8.	Stanton, R.L. (1972): Ore Petrology, McGraw Hill.
9.	Wolf, K.H. (1976-1981): Hand-Book of Stratabound and Stratiform Ore Deposits, Elsevier Publ.

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YEAR	III	**Major Paper III:**	CREDIT	4
Semester	II	**GLM3026C Exploration and Mining Geology**	HOURS	60

OBJECTIVES:	To understand the stages and methods of mineral exploration, including geophysical and geochemical techniques, and to apply geological principles in mining operations, safety, and environmental impact assessments.

COURSE CONTENT / SYLLABUS

UNIT-I	**Theory** Stages of exploration; Mineral prospecting; Lieses, licences and permits; Types of discovery; Geological criteria, guides, and indicators for mineral exploration. Concepts of resources and reserves; UNFC classification; Geochemical methods, mobility, and geochemical associations of elements.	15 hrs.
UNIT-II	**Theory** Geophysical exploration methods - Gravity, Magnetic, Seismic, Electrical. Basics of logging. Drilling techniques. Sampling methods. Use of remote sensing in mineral exploration.	15 hrs.
UNIT-III	**Theory** Types of mines and various mine workings. Safety measures in mining. Geological considerations for selection of mining method; Surface mining methods - Mechanical excavation and aqueous mining; Underground mining methods for metallic and non-metallic minerals, and coal; Mining machinery; Mine planning and ventilation. Mine development; Methods of shaft sinking. Environmental impacts of mining.	15 hrs.
UNIT-IV	**Practical** Survey-based exercises. Understanding and interpretation of remote sensing data for mineral exploration. Interpretation of borehole data and fence diagrams. Calculation of average assay value by using sampling data obtained by drilling and by sampling in underground mine workings.	15 hrs.

REFERENCES

1.	Halder, S., K., Mineral Exploration: Principles and Applications, Elsevier
2.	Hartman and Mutmansky, Introductory Mining Engineering, Wiley
3.	P.K. Banerjee and S Ghosh (1997): Elements of prospecting for non-fuel mineral deposits.
4.	Bagchi, T.C., Sengupta, D.K., Rao, S.V.L.N. (1979): Elements of Prospecting and Exploration.
5.	Sinha, R.K. and Sharma, N.L. (1976) Mineral Economics.
6.	McKinstry, H.E. Mining Geology, Prentice Hall, Englewood Cliffs, N.J.
7.	Clark, G.B. (1967) Elements of Mining, III ed. John Wiley.
8.	Arogyaswami, R.P.N. (1996) Courses in Mining Geology, IV Ed. Oxford IBH.
9.	Thomas, L.J. (1978) An Introduction to Mining, Methuen, Brisbane.
10.	Evans, A.M. Introduction to Mineral Exploration, Blackwell Science, Oxford, 1995

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YEAR	III	**Minor Paper I:**	CREDIT	4
Semester	II	**GLE3006C Stratigraphy and Phanerozoic geology of India**	HOURS	60

OBJECTIVES:	To study the geological history, paleogeography, and significant stratigraphic boundaries of the Palaeozoic, Mesozoic, and Cenozoic eras, with a focus on Indian Mesozoic successions, volcanic provinces, and the tectonic evolution of the Indian plate.

COURSE CONTENT / SYLLABUS

UNIT-I	**Theory** Geological history, life; Paleoenvironment and paleogeography of the Paleozoic, Mesozoic and Cenozoic eras; Major stratigraphic boundaries- concept, geological events, extinction and GSSP of Permian-Triassic boundary, Cretaceous-Tertiary boundary, Neogene-Quaternary boundary and Pleistocene-Holocene boundary.	15 hrs.
UNIT-II	**Theory** Detailed study of important Paleozoic successions in India with emphasis on structural and tectonic set up, lithology , stratigraphy and paleo-environment of the Salt range, Spiti and Kashmir; Distribution, stratigraphy, structure, fossils and economic importance of Gondwana basin.	15 hrs.
UNIT-III	**Theory** Detailed study of important Mesozoic successions in India with emphasis on structural and tectonic set up, lithology, stratigraphy and paleo-environment of the Spiti, Kachchh, Saurashtra, Rajasthan; Cauvery and Narmada basins; Volcanic Provinces of India- Deccan Volcanic Province, Rajmahal and Sylhet Traps.	15 hrs.
UNIT-IV	**Theory** Detailed study of important Tertiary and Quaternary successions in India with emphasis on structural and tectonic set up, lithology , stratigraphy, fossil assemblage and paleo environment of the Kachchh, Saurashtra, Cambay, Siwalik, Assam-Arakan and Kashmir basins. Seismic history and seismic zones of India.	15 hrs.

REFERENCES

1.	Ramakrishnan, M., & Vaidyanadhan, R. (2008). Geology of India (Vol 1 and 2), Geological Society of India.
2.	Krishnan, M. S. (1982) Geology of India and Burma, CBS Publishers, Delhi
3.	Salvador, A. (Ed.). (1994). International stratigraphic guide: a guide to stratigraphic classification, terminology, and procedure (No. 30). Geological Society of America.
4.	Doyle, P., & Bennett, M. R. (Eds.). (1998). Unlocking the stratigraphical record: advances in modern stratigraphy. John Wiley & Sons
5.	https://stratigraphy.org

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YEAR	III	**SEC3436C Internship/ Course/ Project/ Fieldwork**	CREDIT	4
Semester	II		HOURS	60

OBJECTIVES:	The outcome of this course is aimed to focus on the applications of geological knowledge and hands on training by working in different industries and terrains.

COURSE CONTENT / SYLLABUS

UNIT-I	<<Title>>	15 hrs.
UNIT-II	<<Title>>	15 hrs.
UNIT-III	<<Title>>	15 hrs.
UNIT-IV	<<Title>>	15 hrs.

REFERENCES

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YEAR	III	**AEC:**	CREDIT	2
Semester	II	**AEC3396C Analytical Techniques in Geoscience**	HOURS	30

OBJECTIVES:	To understand the principles, applications, and limitations of advanced analytical techniques in geology, such as XRD, SEM-EDX, ICPMS, and isotopic dating, while gaining practical experience in sample processing, data interpretation, and case studies.

COURSE CONTENT / SYLLABUS

UNIT-I	**Theory** Principles, applications and limitations of XRD, Petrographic microscope, SEM-EDX, EPMA, AAS, ICPMS- ICPOES, XRF, Granulometric analysis, hydrometric methods, Permeameter, Multi-parametric meter, Ion & gas chromatography, Isotope ratio mass spectrometer, OSL dating, Fourier transform infrared spectroscopy, Total environment analysis.	15 hrs.
UNIT-II	**Practical** Case studies and hands-on training in sample processing, analytical methods and interpretation of data.	15 hrs.

REFERENCES

1. Rollinson, H. R. (2014). Using geochemical data: evaluation, presentation, interpretation. Routledge.
2. Carver, R. E. (1971). Procedures in sedimentary petrology.
3. Folk, R. L. (1980). *Petrology of sedimentary rocks*. Hemphill publishing company.
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