

		The Maharaja Sayajirao University of Baroda Faculty of Science, Department of Geology		ACADEMIC YEAR 2026-27		
B.Sc. GEOLOGY: Regular (NEP 2020)						
YEAR	IV	GLM4007C: Petrogenesis of Igneous Rocks			CREDIT	4
Semester	I				HOURS	90
OBJECTIVES:		To understand magma generation, differentiation processes, phase equilibria, and tectonic settings of igneous rocks through petrogenetic classification and geochemical plotting techniques.				
COURSE CONTENT / SYLLABUS						
UNIT-I	THEORY Concept of partial melting; Role of pressure, temperature and volatiles; Heat transfer and temperature gradient; Crystal growth, nucleation and zoning, Primary and secondary textures; cumulates and crystal mush systems; Mode and norms (CIPW) classification schemes, Thermodynamics: Gibbs free energy, phase equilibria and lever rule; Ternary (Di-An-Alb, Di-Fo-Si, Di-Fo-An, Fo-An-Si and Ne-Ks-Si) and quaternary systems; Magma series; Element distribution and partition coefficient; Concept of batch melting, fractional melting and Rayleigh fractionation; Role of trace elements in igneous systems.				15 hrs.	
	THEORY Magmatic differentiation and other processes; Layered mafic intrusions; Intraplate and interplate volcanism: Generation of MORB, island arc magmatism, continental flood basalts, and hotspot volcanism with global examples; Continental rift associated magmatism, Magmatic processes and introduction of some common alkaline Rocks: Carbonatites, Anorthosites, Lamprophyres, Lamproites and Kimberlites; Genesis and classification of Granitoids; Role of igneous petrology in geothermal energy, mineralization, and CO2 removal.				15 hrs.	
UNIT-III	LAB				30 hrs.	
	Petrogenesis of felsic and mafic rocks; QAPF and TAS plots, CIPW normative calculation, Practical interpretation of phase diagrams & crystallization sequences.					
UNIT-IV	LAB				30 hrs.	
	Exercise to differentiate the igneous rock type and basic plots such as binary (V versus Ti, Nb/Yb versus Th/Yb; Zr/Y versus Nb/Y) and ternary Ti-Zr-Y, Th-Hf-Ta, MnO ₂ -TiO ₂ -P ₂ O ₅ ; Mineralogical differentiation diagram: SiO ₂ versus Na ₂ O+ K ₂ O-CaO; Feldspar Ternary (An-Ab-Or), Basic exercises using Igneous petrology softwares.					
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.					
5.	Robin Gill (2010) Igneous Rocks and Processes: a practical guide. John Wiley& Sons					
6.	Srivastava, Rajesh K. and Chandra, R., (1995): Magmatism in Relation to Diverse Tectonic Settings, A.A. Balkema, Rotterdam.					

		The Maharaja Sayajirao University of Baroda Faculty of Science, Department of Geology		ACADEMIC YEAR 2026-27	
B.Sc. GEOLOGY: Regular (NEP 2020)					
YEAR	IV	GLM4017C: Petrogenesis of Metamorphic Rocks		CREDIT	4
Semester	I			HOURS	90
OBJECTIVES:		To understand metamorphic reaction mechanisms, facies concepts, fluid-rock interactions, P-T-t path construction, and thermobarometric techniques through microscopic analysis and phase equilibria modeling.			
COURSE CONTENT / SYLLABUS					
UNIT-I	THEORY				15 hrs.
	Concept of metamorphism and grade; Micro-scale and meso-scale structures: Crystal growth, nucleation and diffusion; Dynamic recrystallization and porphyroblast-matrix relations; Metamorphic reactions: Polymorphic reactions, exsolution, solid-solid net transfer, devolatilization, continuous, ion exchange, oxidation/reduction reactions; Relationship between deformation and metamorphism: Deformation vs metamorphic mineral growth, Analysis of polydeformed and polymetamorphosed rocks; Textural geochronology.				
UNIT-II	THEORY				15 hrs.
	Concept of Metamorphic facies; Metamorphic facies series: Barrovian, Buchan and high-pressure facies, Metamorphic fluids: Types of metamorphic fluids, fluid sources, composition, evolution, Role of fluids in mineral reaction, Fluid-rock interaction processes, Infiltration-driven metamorphism; Partial melting and HP/UHP crustal processes; P-T-t-d path construction; Concept of geothermobarometry; Emerging trends in metamorphic petrology.				
UNIT-III	LAB				30 hrs.
	Microscopic studies of reaction textures, metamorphic mineral growth; ACF, AKF, AFM, A'KF, CMASH systems				
UNIT-IV	LAB				30 hrs.
	Conventional thermobarometers (garnet biotite, GASP, Grt-Opx), Pseudosection modelling using THERMOCALC, Perple_X				
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.				

		The Maharaja Sayajirao University of Baroda Faculty of Science, Department of Geology		ACADEMIC YEAR 2026-27	
B.Sc. GEOLOGY: Regular (NEP 2020)					
YEAR	IV	GLM4027C: Geochemistry		CREDIT	4
Semester	I			HOURS	75
OBJECTIVES:		To provide fundamental understanding of geochemical principles, elemental behavior, water-rock interactions, stable and radiogenic isotope systematics, and geochronological dating methods with practical applications.			
COURSE CONTENT / SYLLABUS					
UNIT-I		THEORY		15 hrs.	
		Fundamental concepts of geochemistry; Periodic property of elements; Geochemical systems: Open, closed, isolated, chemical composition of the Universe – cosmic abundance; Geochemical classification of elements. Element partitioning in mineral/rock formation and concept of distribution coefficient, Crust, Mantle, and Core composition, Continental vs. oceanic crust, Geochemical behavior of Major, Trace, Rare Earth Elements (REE) and PGE; Meteorites, their classification, mineralogy, and origin.			
UNIT-II		THEORY		15 hrs.	
		Water–rock interaction mechanisms, Oxidation-reduction reaction, Chemical precipitation and stability of minerals, acids and bases, salts and their ions, Carbonate system: CO ₂ –H ₂ O–CaCO ₃ equilibrium, Eh-pH dependence, Composition of seawater, groundwater, rivers; Biogeochemical cycles: carbon, sulfur, nitrogen, phosphorus. Concept of equilibrium, Entropy, enthalpy, Gibbs free energy, and laws of thermodynamics. Stable isotopes: δ ¹⁸ O, δ ¹³ C, (‰ vs. SMOW, PDB), Isotope fractionation and its applications for Paleoclimate.			
UNIT-III		THEORY		15 hrs.	
		Introduction to sedimentary geochemistry: Geochemical processes involved in rock weathering, CO ₂ sequestration, and soil formation. Radiogenic isotopes, α, β, γ decay principles; decay constant, half-life, Equations of Radioactive Decay and Radiogenic Growth, Geochronology using radioactive decay schemes of Rb-Sr, Sm-Nd, U-Th-Pb, K-Ar, U-series disequilibrium method of dating, ¹⁴ C dating, Fission track Dating, Isotope Geochemistry of the Earth's Mantle and crust			
UNIT-IV		LAB		30 hrs.	
		Mineral formula calculations, LOI determination, Binary plots of trace elements			
REFERENCES					
1.	Mason, B. Principles of Geochemistry, Wiley, 1982				
2.	Allègre, C.J. Isotope Geology, Cambridge University Press, 2008				
3.	Faure, G. Principles of Isotope Geology, Wiley, 1986				
4.	White, W.M. Geochemistry, Wiley-Blackwell, 2013				
5.	Wood, B.J. and Fraser, D.G. Elementary Thermodynamics for Geologists, Oxford University Press, 1977				
6.	Anderson, G.M. Thermodynamics of Natural Systems, Cambridge University Press, 2005				

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B.Sc. GEOLOGY: Regular (NEP 2020)					
YEAR	IV	GLE4007C: Quaternary Geology and Evolution of Human Civilization		CREDIT	4
Semester	I			HOURS	75
OBJECTIVES:		To understand Quaternary climatic and sea level changes, paleoclimate reconstruction methods, climatic geomorphology, and correlation between environmental changes and human cultural evolution.			
COURSE CONTENT / SYLLABUS					
UNIT-I	THEORY				15 hrs.
	Nature and major characteristics of Quaternary period, time divisions of Pleistocene and Holocene, Quaternary climatic changes-glacial and interglacial periods, linkage to cultural evolution. Sea level changes – Eustatic Sea Level (ESL), Relative Sea Level (RSL), glacio-eustasy, tectono-eustasy, Quaternary fauna and flora, Quaternary sea level changes and climatic changes, Ocean gateways of the Quaternary and their role in controlling global climates and migration patterns. Sea level changes during Quaternary with special reference to India. Application of stable isotopes (Oxygen and Carbon) in Paleoceanography and Paleoclimatology.				
UNIT-II	THEORY				15 hrs.
	Distinction between weather and climate, Components of the climate system Concept of morphoclimatic zone, morphogenetic region and climatic geomorphology, Koppen’s classification of climate. Morphogenetic regions of the world – processes and landforms. Milankovitch cycles and variability in the climate, Magnetostratigraphy-principles, types of magnetism, Global Magnetic Polarity Timescale (GMPTS), applications in understanding sedimentation history. Brief introduction to archives of climate change: Climatic record from deep sea sediment archives- history of deep sea coring, Characteristics and types of deep-sea sediments, Deep Sea record and major Cenozoic climatic events, Glacial-interglacial stages -Marine Isotopic Stages –basis and implication for sea level change and climate. Ice-cores and palaeoclimate. Paleoclimatic reconstructions from ice cores. Climate Change: natural vs. anthropogenic effects, Future perspectives				
UNIT-III	THEORY				15 hrs.
	Concept of culture and civilization; stages of prehistoric cultural evolution—Palaeolithic, Mesolithic, Neolithic, and Chalcolithic; geographical factors in the rise of civilization; early human settlements in the Indian subcontinent; origin, extent, and salient features of the Indus Valley Civilization; post-Harappan cultural developments; early urbanization in India; civilization and environment in the Indian context.				
UNIT-IV	LAB				30 hrs.
	Interpretation of Quaternary sediments, stratigraphic columns, and depositional environments; exercises on sea level curves and coastal geomorphic indicators; map-based study of Quaternary landforms and environmental changes.				
REFERENCES					
1.	Bradley, R.S. Paleoclimatology: Reconstructing Climates of the Quaternary				
2.	Cronin, T.M. Paleoclimates: Understanding Climate Change Past and Present				
3.	Elias, S.A. & Mock, C.J. (eds.) Encyclopedia of Quaternary Science				
4.	Maher, B.A. & Thompson, R. Quaternary Climates, Environments and Magnetism				
5.	Valdiya, K.S. Neotectonism in the Indian Subcontinent				
6.	Kumaran, K.P.N. (ed.) Holocene Climate Change and Environment				
7.	Allchin, B. & Allchin, R. The Rise of Civilization in India and Pakistan				
8.	Coningham, R. & Young, R. The Archaeology of South Asia: From the Indus to Asoka, c. 6500 BCE–200 CE				

	The Maharaja Sayajirao University of Baroda Faculty of Science, Department of Geology			ACADEMIC YEAR 2026-27	
B.Sc. GEOLOGY: Regular (NEP 2020)					
YEAR	IV	GLM4047C: Ocean, Atmospheric and Planetary science	CREDIT	4	
Semester	I		HOURS	75	
OBJECTIVES:		To understand oceanic processes, planetary surface features, atmospheric structure, and meteorological data analysis through integrated study of Earth and planetary systems.			
COURSE CONTENT / SYLLABUS					
UNIT-I	THEORY Morphology of the ocean floor; physical structure of the ocean; major and minor solutes in ocean water; salinity—causes, controlling factors, and its effects on the properties of ocean water; waves and tides—types, wave motion, and origin of tides; economic importance of ocean basins. Wind and ocean circulation and their controlling factors; downwelling and upwelling; surface and deep ocean circulation; ocean-atmosphere interaction and climate, with special reference to El Niño, La Niña, and the Indian Ocean Dipole (IOD)				15 hrs.
UNIT-II	THEORY Interpretation of satellite imageries of planets (morphology and spectral data), Missions to study Planets and Extrasolar planets, Overview of rovers and landers used to study planetary materials, Inference of presence of water pockets using magnetic resonance sounding in terrestrial planets and moons Search for extraterrestrial life, Contamination protocols for robotic and human missions. Planetary Surface Processes- Impact Cratering: Impact mechanics, crater types, shock metamorphism, and age dating based on crater density, Comparison of volcanic landforms (shield volcanoes, lava plains) and tectonic features across the solar system. Morphology and geological history of Planetary bodies				15 hrs.
UNIT-III	THEORY Elementary concepts of atmospheric sciences; vertical thermal structure and composition of the atmosphere; hydrostatics of the atmosphere; geopotential; equipotential surface; hydrostatic equation; hydrostatic equilibrium. Weather Data Analysis and Forecasting General measurement system: Principles; measurement of surface meteorological parameters rainfall, wind, temperature, humidity, pressure, radiation, soil moisture and soil temperature; Aerosol and its size distribution and chemical compositions; trace gases; Ship-based and buoys observations. Upper air observations: Pilot balloon; radiosonde/GPSSonde; Data analysis and forecasting: Surface and upper air data analysis; T-Phigram; use of weather charts and T-Phigram for weather forecasting				15 hrs.
UNIT-IV	LAB Impact Cratering Analysis: Measuring the size-frequency distribution of craters to estimate the relative or absolute age of a planetary surface.				30 hrs.
REFERENCES					
1.	Talley, L. D., Pickard, G. L., Emery, W. J., & Swift, J. H. (2011). <i>Descriptive physical oceanography: An introduction</i> (6th ed.). Academic Press.				
2.	Pond, S., & Pickard, G. L. (1983). <i>Introductory dynamical oceanography</i> (2nd ed.). Butterworth-Heinemann.				
3.	Open University Course Team. (2000). <i>Waves, tides and shallow-water processes</i> (2nd ed.). Butterworth-Heinemann.				
4.	Barry, R. G., & Chorley, R. J. (2009). <i>Atmosphere, weather and climate</i> (9th ed.). Routledge.				
5.	Wallace, J. M., & Hobbs, P. V. (2006). <i>Atmospheric science: An introductory survey</i> (2nd ed.). Academic Press				
6.	Holton, J. R., & Hakim, G. J. (2012). <i>An introduction to dynamic meteorology</i> (5th ed.). Academic Press.				
7.	de Pater, I., & Lissauer, J. J. (2015). <i>Planetary sciences</i> (2nd ed.). Cambridge University Press.				
8.	Melosh, H. J. (2011). <i>Planetary surface processes</i> . Cambridge University Press.				
9.	Greeley, R. (Ed.). (2013). <i>Introduction to planetary geomorphology</i> . Cambridge University Press.				
10.	Pinet, P. R. (1992). <i>Oceanography: An introduction to the planet Oceanus</i> (2nd ed.). West Publishing Company				

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B.Sc. GEOLOGY: Regular (NEP 2020)						
YEAR	IV	SEC4147C: Geochemistry Lab			CREDIT	2
Semester	I				HOURS	60
OBJECTIVES:		To develop practical skills in geochemical weathering index calculation, elemental plotting techniques, and sample digestion methods for major, trace, and rare earth element analysis.				
COURSE CONTENT / SYLLABUS						
UNIT-I	LAB				30 hrs.	
	Calculation of CIA, CIW, PIA, and MIA; Harker Plots; REE and ternary (La-Th-Sc) plots.					
UNIT-II	LAB				30 hrs.	
	Sample digestion techniques for Major, trace, and REE analysis of soil and rock samples.					
REFERENCES						
1.	Mason, B. Principles of Geochemistry, Wiley, 1982					
2.	Allègre, C.J. Isotope Geology, Cambridge University Press, 2008					
3.	Faure, G. Principles of Isotope Geology, Wiley, 1986					
4.	White, W.M. Geochemistry, Wiley-Blackwell, 2013					
5.	Wood, B.J. and Fraser, D.G. Elementary Thermodynamics for Geologists, Oxford University Press, 1977					
6.	Anderson, G.M. Thermodynamics of Natural Systems, Cambridge University Press, 2005					

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B.Sc. GEOLOGY: Regular (NEP 2020)					
YEAR	IV	GLJ4007C: On the Job Training in Geology – I		CREDIT	6
Semester	I			HOURS	
OBJECTIVES:		To provide practical industry exposure, enabling application of geological concepts and skills in real-world professional work environments and operational settings.			
COURSE CONTENT / SYLLABUS					
	ON THE JOB TRAINING (OJT)				

		The Maharaja Sayajirao University of Baroda Faculty of Science, Department of Geology		ACADEMIC YEAR 2026-27	
B.Sc. GEOLOGY: Regular (NEP 2020)					
YEAR	IV	GLM4008C: Advanced Paleontology		CREDIT	4
Semester	II			HOURS	90
OBJECTIVES:		To understand fossil preservation, evolutionary patterns, biostratigraphic correlation, paleoecological reconstruction, and ichnological applications through integrated theoretical concepts and quantitative laboratory techniques.			
COURSE CONTENT / SYLLABUS					
UNIT-I	THEORY				15 hrs.
	Precambrian–Cambrian transition and origin of Metazoa (Ediacaran–Cambrian radiation), Taphonomy as a filter: Biases in preservation, time-averaging, condensation , Quantitative approaches to fossil preservation (preservation windows, Lagerstätten); Species concepts: Morphospecies vs biological species vs phylogenetic species; Ontogeny and population structure in fossil assemblages Functional morphology and ecological inference ; Introduction to Paleoecology & Paleobiogeography; Fossil record completeness and sampling standardization.				
UNIT-II	THEORY				15 hrs.
	Introduction to paleodiversity curves and biases; Modes of evolution: Gradualism vs punctuated equilibrium; Adaptive radiation, ecological opportunity, and constraints; Sepkoski Dataset and Model; Major evolutionary transitions (vertebrates, plants, marine ecosystems); Mass extinctions & recovery dynamics (focus on Permian–Triassic, K–Pg); Biotic interactions: Predation, competition, symbiosis Trace fossils as proxies for oxygenation and energy conditions Ichnology in: Sequence stratigraphy; Reservoir quality prediction. Biostratigraphy & Correlation Biozones: Range, assemblage, abundance zones ; Index fossils and correlation techniques Integration with litho- and sequence stratigraphy Paleoclimate & Paleoenvironmental Reconstruction Fossils as proxies for: Temperature; Oxygen levels; Sea-level change; Stable isotopes (basic introduction)				
UNIT-III	LAB				30 hrs.
	Practical related to Fossilization potential and modes of preservation; Fossil identification and morphology; Biostratigraphic correlation exercises; Trace fossil interpretation problems; Case studies (deltaic, estuarine, deep marine systems)				
UNIT-IV	LAB				30 hrs.
	Quantitative Morphometrics (ImageJ-based basics); Diversity indices; Paleoecological modeling; Evolutionary Modelling, sepkoski Data plotting and interpretation, Ichnofacies models: Skolithos, Cruziana, Zoophycos, Nereites Ichnofabric analysis and Bioturbation Index (BI).				
REFERENCES					
1.	Clarkson, E.N.K.1998. Invertebrate Palaeontology and Evolution, George Allen & Unwin.				
2.	Raup, D.M. and Stanley, S. M. 1971. Principles of Palaeontology, W.H. Freeman and Company.				
3.	Benton, M. 1997. Basic Palaeontology: An introductory text, D.Harker, Addison Wisely Longman.				
4.	Benton, M.J. 2005. Vertebrate palaeontology (3rd edition). Blackwell Scientific, Oxford.				
5.	Willis, K.J. & McElwain, J.C. 2002. The evolution of plants, Oxford University Press.				
6.	Foote, M. & Miller, A. I. (2006). Principles of Paleobiology, third edition.				
7.	Shukla, A. C. & Mishra, S.P. (1982).Essentials of Palaeobotany.				

		The Maharaja Sayajirao University of Baroda Faculty of Science, Department of Geology		ACADEMIC YEAR 2026-27	
B.Sc. GEOLOGY: Regular (NEP 2020)					
YEAR	IV	GLM4018C: Landscape Evolution		CREDIT	4
Semester	II			HOURS	75
OBJECTIVES:		To understand landscape evolution models, controlling factors, soil formation processes, morphostratigraphic concepts, and morphometric analysis techniques using field and GIS-based approaches.			
COURSE CONTENT / SYLLABUS					
UNIT-I	THEORY				15 hrs.
	Models of landscape evolution-Evolutionary cycle, slope replacement model, pediplanation model, equilibrium model. Introduction to controlling factors of landscape evolution-climate, tectonics and sea level change. Role of lithology in landscape evolution in granitic, limestone and volcanic terrains; Earthquake induced surface changes. Slopes-classification, geomorphic processes on slopes and evolution.				
UNIT-II	THEORY				15 hrs.
	Soil terminology, components, soil profile and discrimination, Factors affecting soil formation, soil properties-physical and chemical, Pedogenic processes-physical and chemical weathering, Diagnostic soil horizons, Soil Taxonomy-soil orders. Recognition and characteristics of palaeosols. Palaeoclimatic interpretation of soils. Geomorphology and morphogenesis of the Lunar and Martian landforms, Application of geomorphology in environmental management, hydrology, mineral exploration, engineering, coastal zone management, hazard analysis, regional and urban planning. Role of humans as geomorphological agents.				
UNIT-III	THEORY				15 hrs.
	Morphostratigraphy-concept and approaches-lithostratigraphic, allostratigraphic, pedostratigraphic and relative dating. Geomorphological mapping – analog and digital techniques, Morphometric analyses of drainage basins-morphometric indices, analysis and interpretation using GIS, DEM-types of DEMs, data sources and landscape analysis.				
UNIT-IV	LAB				30 hrs.
	Preparation and interpretation of geomorphic maps; identification and delineation of major geomorphic features. Morphometric analysis of drainage basins, including linear, areal, and relief aspects; interpretation of drainage characteristics and their geomorphological significance.				
REFERENCES					
1.	Summerfield, M. A. (2014). <i>Global geomorphology</i> . Routledge.				
2.	Huggett, R., & Shuttleworth, E. (2022). <i>Fundamentals of geomorphology</i> . Routledge.				
3.	Buol, S. W., Southard, R. J., Graham, R. C., & McDaniel, P. A. (2011). <i>Soil genesis and classification</i> . John Wiley & Sons.				
4.	Brady, N. C., Weil, R. R., & Weil, R. R. (2008). <i>The nature and properties of soils</i> (Vol. 13, pp. 662-710). Upper Saddle River, NJ: Prentice Hall.				
5.	Retallack, G. J. (2008). <i>Soils of the past: an introduction to paleopedology</i> . John Wiley & Sons.				
6.	Baker, V. R. (2013). Introduction to planetary geomorphology. <i>Meteoritics & Planetary Science</i> , 48(9).				
7.	Wilson, J. P., & Gallant, J. C. (Eds.). (2000). <i>Terrain analysis: principles and applications</i> . John Wiley & Sons.				

	The Maharaja Sayajirao University of Baroda Faculty of Science, Department of Geology			ACADEMIC YEAR 2026-27	
B.Sc. GEOLOGY: Regular (NEP 2020)					
YEAR	IV	GLM4028C: Sedimentology and Basin Analysis	CREDIT	4	
Semester	II		HOURS	75	
OBJECTIVES:		To understand sedimentary diagenesis, depositional environments, basin analysis techniques, and sequence stratigraphy through integrated theoretical concepts and petrographic laboratory studies.			
COURSE CONTENT / SYLLABUS					
UNIT-I	THEORY Overview of Siliciclastic and Carbonate system. Introduction to Mixed-siliciclastic rocks. Diagenesis of siliciclastic sedimentary rocks: Stages and realms, processes and effects. Diagenesis of carbonate sedimentary rocks: Regimes, processes and changes. Paleocurrent analysis: Paleocurrent indicators, Measurement technique, Calculation, Representation of data (Rose diagram, Vector method, Trigonometric method) and interpretation. Provenance analysis: Methods (Petrography, Heavy mineral analysis, Geochemical analysis), Types and characteristics of tectonic provenance settings (Continental block, Recycled Orogen, Magmatic Arc), Dickinson’ s model.				15 hrs.
	UNIT-II THEORY Depositional environment: Introduction and Classification. Continental environments: Fluvial, Aeolian, Lacustrine and Glacial systems. Marginal Marine environment: Deltaic, beach and barrier island, Estuarine, Lagoonal and Tidal-flat systems. Siliciclastic Marine environment: Shelf and deep-water environment. Carbonate and Evaporite environments: Non-reef, Organic reef and evaporite environments, Mixed Carbonate-Siliciclastic Systems.				
UNIT-III	THEORY Introduction to Basin Analysis. Mechanisms of basin formation (subsidence). Plate tectonics and basins. Kinds of sedimentary basins- basins in divergent settings, basins in intraplate settings, basins in convergent settings, basins in strike-slip/ transform-fault-related settings, basins in hybrid settings. Sedimentary basin fill. Techniques of basin analysis- measuring stratigraphic sections, preparing stratigraphic maps and cross sections, Siliciclastic petrofacies (provenance) studies, Geophysical studies. Applications of basin analysis: interpreting geologic history economic applications. Sea level changes and sedimentation. Depositional sequences and tracts, Parasequences, Sequence stratigraphy in marine and non-marine basins. Applications of sequence stratigraphy				15 hrs.
	UNIT-IV	LAB Detailed petrographic studies of siliciclastic, carbonate and mixed-siliciclastic carbonate sedimentary rocks. Practicals related to Paleocurrent and Provenance analysis.			
REFERENCES					
1.	Lindholm, R.C., 1987. A Practical Approach to Sedimentology, AllcneUnwin, London.				
2.	Pettijohn, F.J., 1975. Sedimentary Rocks, Harper and Row Publ. New Delhi.				
3.	Nichols, G., 1999. Sedimentology and Stratigraphy, Blackwell publishing.				
4.	Sam Boggs, 1995. Principles of Sedimentology and Stratigraphy, Print iceHall, New Jersey.				
5.	Tucker, M.E., 2006. Sedimentary Petrology. Blackwell Publishing				
6.	Principles of Sequence Stratigraphy: Octavian cateneauau (2006) Elsevier				

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B.Sc. GEOLOGY: Regular (NEP 2020)					
YEAR	IV	GLE4008C: Structural Analyses of Rocks		CREDIT	4
Semester	II			HOURS	75
OBJECTIVES:		To provide comprehensive understanding of fold-fault mechanics, fracture systems, rock deformation behavior, shear zone kinematics, and strain analysis through theoretical concepts and practical structural geology applications.			
COURSE CONTENT / SYLLABUS					
UNIT-I	THEORY				15 hrs.
	Fold interference and superposed folds. Modes of superposed buckling in single and multilayers. Mesoscopic and macroscopic analyses of superposed folds. Problem of co-axial folding Mechanics of faulting: Complex geometry of normal, strike-slip and thrust faults with natural examples. Hafners analyses Concept of fault zone weakening; fault reactivation and its significance. Concept of balanced cross sections; Fold and thrust belts.				
UNIT-II	THEORY				15 hrs.
	Fracture mechanics; Mechanics of rock fracturing: fracture initiation and propagation; Coulomb's criterion and Griffith's theory; Geometrical analyses of joints and their Importance Mechanical aspects of fracturing and joint formation. Joints with relation to folds and faults. Joints in relation to tectonic cycle, Orientation analyses of joints. Different types of planar and linear structures in deformed rocks; Origin of rock cleavage and its mechanism. Axial plane cleavage in relation to principal axes of finite strain. Lineations in superposed deformation, Patterns of deformed early lineation, Boudinage in superposed deformation, origin of boudins-sequential and simultaneous development, rotated boudins, asymmetric boudins, shear fracture boudins, foliation boudins, boudinage in relation to granitization and metamorphism.				
UNIT-III	THEORY				15 hrs.
	Behavior of rocks under stress- elastic, plastic, viscous and visco-elastic responses and their geological significance; Strain analysis: deformation mechanism at different scales, dislocation and diffusion creep, strain hardening and softening, lattice preferred orientation, Granular flow, super plasticity. Stress tensor, role of fluid in deformation; Time relation between crystallization and deformation in rocks. Shear Zones – Types and associated rocks, analysis of strain in shear zones; kinematic significance of different shear zone structures; Shear sense indicators; Folding in shear zones, Flow behaviour of sheared rocks. Large scale shear zones and their importance in continental crustal evolution.				
UNIT-IV	LAB				30 hrs.
	Interpretation of geological maps and sections. Calculation of strain parameters, Exercises on balanced cross sections. Analysis of structural data using softwares. Numerical problems related to rock beds.				
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				

		The Maharaja Sayajirao University of Baroda Faculty of Science, Department of Geology		ACADEMIC YEAR 2026-27	
B.Sc. GEOLOGY: Regular (NEP 2020)					
YEAR	IV	GLM4038C: Coal and Petroleum Geology		CREDIT	4
Semester	II			HOURS	75
OBJECTIVES:		To understand petroleum origin, migration, reservoir characteristics, exploration methods, well log interpretation, coal formation, and their applications in hydrocarbon resource assessment.			
COURSE CONTENT / SYLLABUS					
UNIT-I	THEORY Historical development of petroleum geology, Inorganic and organic theories of origin of petroleum, Physical and chemical properties of petroleum and related substances. Surface and subsurface geographic and stratigraphic occurrence of petroleum. Environments and processes of transformation of source material to petroleum hydrocarbons. Migration of petroleum hydrocarbons: primary and secondary migration. Factors causing migration of petroleum Reservoir rocks: characteristics of reservoir rocks and their types. Principles of determination of porosity and permeability. Traps: characteristics and classification. Structural, stratigraphic, combination and fluid barrier traps. Accumulation of fluid petroleum, Petroleum prospects: Important oil & gas fields and petroleum prospects of India.Functions of Petroleum Geologist.				15 hrs.
	UNIT-II THEORY Geological, geophysical and geochemical methods of petroleum exploration. Estimation of petroleum reserves: brief outline of methods of estimation of petroleum reserves, Different methods of drilling; Coring; Drilling rigs, Drill holes, Casing and Cementation; Drilling fluids. Well completion. Formation evaluation - Geologging and well logs - Caliper, SP, Gamma Ray, Resistivity, Neutron, and Density Electric, Radioactive and Acoustic.				15 hrs.
UNIT-III	THEORY Origin of Coal, formation of coal, carbonization, coal forming epochs in the geological history, sedimentology of coal bearing strata, mode of occurrence of structures associated with coal seams, classification of coal, chemical analysis of coal. Macroscopic and microscopic constituents of coals. Application of reflectance and fluorescence study of coal. Coal bed methane.Coal deposits of India and depositional environment of some important coal fields of India. Methods of Coal prospecting and estimation of its reserves. Coal Industry in India.				15 hrs.
	UNIT-IV LAB Practical exercises using field sections, sediment logs, and hand specimens. Well log interpretation (Caliper, SP, Gamma Ray, Resistivity, Neutron, and Density): (i) Prediction of Lithology (ii) Calculating petrophysical properties - Porosity, Permeability and Water saturation etc. Well log correlation; preparation and interpretation of subsurface correlation panels; interpretation of subsurface data for delineation of reservoir, source rock, seal rock, and potential trap horizons; recognition of hydrocarbon-bearing zones using wireline logs, Visit to the drilling rig.				30 hrs.
REFERENCES					
1.	Selley, R. C., & Sonnenberg, S. A. (2022). Elements of petroleum geology (4th ed.). Academic Press.				
2.	Gluyas, J. G., & Swarbrick, R. E. (2021). Petroleum geoscience (2nd ed.). Wiley-Blackwell.				
3.	Hunt, J. M. (1995). Petroleum geochemistry and geology (2nd ed.). W. H. Freeman.				
4.	Kearey, P., Brooks, M., & Hill, I. (2013). An introduction to geophysical exploration (3rd ed.). Wiley-Blackwell.				
5.	Serra, O. (1984). Fundamentals of well-log interpretation, Vol. 1: The acquisition of logging data. Elsevier.				
6.	Serra, O. (1986). Fundamentals of well-log interpretation, Vol. 2: The interpretation of logging data. Elsevier.				
7.	Darling, T. (2005). Well logging and formation evaluation. Gulf Professional Publishing.				
8.	Thomas, L. (2013). Coal geology (2nd ed.). Wiley-Blackwell.				
9.	Flores, R. M. (2014). Coal and coalbed gas: Fueling the future. Elsevier.				
10.	Bastia, R., & Radhakrishna, M. (2012). Basin evolution and petroleum prospectivity of the continental margins of India. Elsevier.				
11.	Mukherjee, S. (Ed.). (2015). Petroleum geosciences: Indian contexts. Springer				

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B.Sc. GEOLOGY: Regular (NEP 2020)					
YEAR	IV	SEC4158C: Digital Image Processing and GIS		CREDIT	2
Semester	II			HOURS	60
OBJECTIVES:		To develop practical skills in remote sensing image processing, GIS software applications, spatial analysis techniques, and thematic map preparation for geospatial data interpretation.			
COURSE CONTENT / SYLLABUS					
UNIT-I	LAB				30 hrs.
	Generation of false colour composites; georeferencing/geometric correction; projections/reprojections; band ratioing (NDWI, NDSI); supervised/unsupervised classification; vector/raster models; editing and attribute management.				
UNIT-II	LAB				30 hrs.
	Satellite data acquisition; Visual image interpretation in GIS; GIS with ArcInfo, ArcEditor, ArcView; spatial analysis (vector/raster); raster basics and map algebra; raster-vector integration (clipping, zonal statistics, buffering, distance, nearest neighbour); query building; spatial interpolation; spatial joins; thematic mapping (choropleth, basemaps); overlay analysis; map composition.				
REFERENCES					
1.	Lillesand, T.M. and Kieffer, R.W., (1987) Remote Sensing and Image Interpretation. John Wiley				
2.	Liu, J. G., & Mason, P. J. (2016). <i>Image processing and GIS for remote sensing: Techniques and applications</i> . John Wiley & Sons.				

		The Maharaja Sayajirao University of Baroda Faculty of Science, Department of Geology		ACADEMIC YEAR 2026-27		
B.Sc. GEOLOGY: Regular (NEP 2020)						
YEAR	IV	GLJ4008C: On the Job Training in Geology – II			CREDIT	6
Semester	II				HOURS	
OBJECTIVES:		To provide practical industry exposure, enabling application of geological concepts and skills in real-world professional work environments and operational settings.				
COURSE CONTENT / SYLLABUS						
		ON THE JOB TRAINING (OJT)				