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|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-----------------------------|---------|----|
|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>The Maharaja Sayajirao University of Baroda</b><br>Faculty of Science,<br>Department of Geology                                                                                           |  | ACADEMIC<br>YEAR<br>2026-27 |         |    |
| <b>M.Sc. Geology: Regular (NEP, 2020) (2 Year Programme)</b>                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                              |  |                             |         |    |
| YEAR                                                                              | I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>GLM5001C: Petrogenesis of Igneous rocks</b>                                                                                                                                               |  |                             | 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. |  |                             |         |    |
| <b>COURSE CONTENT / SYLLABUS</b>                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                              |  |                             |         |    |
| UNIT-I                                                                            | <b>THEORY</b><br>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. |    |
|                                                                                   | <b>THEORY</b><br>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                                                                          | <b>LAB</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                              |  |                             | 30 hrs. |    |
|                                                                                   | Petrogenesis of felsic and mafic rocks; QAPF and TAS plots, CIPW normative calculation, Practical interpretation of phase diagrams & crystallization sequences.                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                              |  |                             |         |    |
| UNIT-IV                                                                           | <b>LAB</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                              |  |                             | 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 <sub>2</sub> -TiO <sub>2</sub> -P <sub>2</sub> O <sub>5</sub> ; Mineralogical differentiation diagram: SiO <sub>2</sub> versus Na <sub>2</sub> O+ K <sub>2</sub> O-CaO; Feldspar Ternary (An-Ab-Or), Basic exercises using Igneous petrology softwares.                                                                                                                                                                                                            |                                                                                                                                                                                              |  |                             |         |    |
| <b>REFERENCES</b>                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                              |  |                             |         |    |
| 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.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                              |  |                             |         |    |

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|  | <b>The Maharaja Sayajirao University of Baroda</b><br>Faculty of Science,<br>Department of Geology                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                    |  | ACADEMIC<br>YEAR<br>2026-27 |         |    |
| <b>M.Sc. Geology: Regular (NEP, 2020) (2 Year Programme)</b>                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                    |  |                             |         |    |
| YEAR                                                                              | I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>GLM5011C: Sedimentology</b>                                                                                                                                                     |  |                             | CREDIT  | 4  |
| Semester                                                                          | I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                    |  |                             | HOURS   | 90 |
| OBJECTIVES:                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | To understand diagenetic processes, paleocurrent and provenance analysis techniques, and depositional environments across siliciclastic, carbonate, and mixed sedimentary systems. |  |                             |         |    |
| <b>COURSE CONTENT / SYLLABUS</b>                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                    |  |                             |         |    |
| UNIT-I                                                                            | <b>THEORY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                    |  |                             | 15 hrs. |    |
|                                                                                   | 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. |                                                                                                                                                                                    |  |                             |         |    |
| UNIT-II                                                                           | <b>THEORY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                    |  |                             | 15 hrs. |    |
|                                                                                   | Depositional environment: Introduction and Classification. Continental environments: Fluvial, Aeolian, Lacustrine and Glacial systems, Coastal and Shallow Sea Sediments (Including Carbonates), Beach and Shoreface Sediments, Sediments of Tidal Flats and Barrier Island-Lagoon Complexes, Sediments of Shallow Seas (Siliciclastics). Carbonate Buildups and Reef-Lagoon Complexes, Sediments of Marine Delta Complexes, Sediments of Adjacent Seas and Estuaries Oceanic Sediments, Water Circulation in the Oceans, Hemipelagic and Pelagic Deep-Sea Sediments, Red Beds and Marine Evaporites.                                                                         |                                                                                                                                                                                    |  |                             |         |    |
| UNIT-III                                                                          | <b>LAB</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                    |  |                             | 30 hrs. |    |
|                                                                                   | Detailed petrographic studies of siliciclastic, carbonate and mixed-siliciclastic carbonate sedimentary rocks.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                    |  |                             |         |    |
| UNIT-IV                                                                           | <b>LAB</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                    |  |                             | 30 hrs. |    |
|                                                                                   | Paleocurrent analysis, Provenance analysis, Identification of sedimentary facies and depositional environments.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                    |  |                             |         |    |
| <b>REFERENCES</b>                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                    |  |                             |         |    |
| 1.                                                                                | Lindholm, R.C., 1987. A Practical Approach to Sedimentology, AllcaneUnwin, 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 ofSedimentology and Stratigraphy, Print iceHall, New Jersey.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                    |  |                             |         |    |
| 5.                                                                                | Tucker, M.E., 2006. Sedimentary Petrology. Blackwell Publishing                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                    |  |                             |         |    |
| 6.                                                                                | Sengupta, S. (2017). <i>Introduction to sedimentology</i> . Routledge.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                    |  |                             |         |    |

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| <b>M.Sc. Geology: Regular (NEP, 2020) (2 Year Programme)</b>                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                               |  |                             |         |
| YEAR                                                                              | I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>GLM5021C: Petrogenesis of Metamorphic Rocks</b>                                                                                                                                                            |  | 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. |  |                             |         |
| <b>COURSE CONTENT / SYLLABUS</b>                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                               |  |                             |         |
| UNIT-I                                                                            | <b>THEORY</b><br>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. |                                                                                                                                                                                                               |  |                             | 15 hrs. |
|                                                                                   | <b>THEORY</b><br>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                                                                          | <b>LAB</b><br>Microscopic studies of reaction textures, metamorphic mineral growth; ACF, AKF, AFM, A'KF, CMASH systems                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                               |  |                             | 30 hrs. |
|                                                                                   | <b>LAB</b><br>Conventional thermobarometers (garnet biotite, GASP, Grt-Opx), Pseudosection modelling using THERMOCALC, Perple_X                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                               |  |                             |         |
| <b>REFERENCES</b>                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                               |  |                             |         |
| 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.                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                               |  |                             |         |

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|  | <b>The Maharaja Sayajirao University of Baroda</b><br>Faculty of Science,<br>Department of Geology                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                   |  | ACADEMIC<br>YEAR<br>2026-27 |         |    |
| <b>M.Sc. Geology: Regular (NEP, 2020) (2 Year Programme)</b>                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                   |  |                             |         |    |
| YEAR                                                                              | I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>GLM5031C: Quaternary Geology and Evolution of Human Civilization</b>                                                                                                                           |  |                             | 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. |  |                             |         |    |
| <b>COURSE CONTENT / SYLLABUS</b>                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                   |  |                             |         |    |
| UNIT-I                                                                            | <b>THEORY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                   |  |                             | 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                                                                           | <b>THEORY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                   |  |                             | 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                                                                          | <b>THEORY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                   |  |                             | 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                                                                           | <b>LAB</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                   |  |                             | 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.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                   |  |                             |         |    |
| <b>REFERENCES</b>                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                   |  |                             |         |    |
| 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                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                   |  |                             |         |    |

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| <b>M.Sc. Geology : Regular (NEP, 2020) (2 Year Programme)</b>                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                          |  |                             |         |    |
| YEAR                                                                              | I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>GLM5041C: Geochemistry</b>                                                                                                                                                                                            |  |                             | 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. |  |                             |         |    |
| <b>COURSE CONTENT / SYLLABUS</b>                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                          |  |                             |         |    |
| UNIT-I                                                                            | <b>THEORY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                          |  |                             | 15 hrs. |    |
|                                                                                   | Fundamental concept 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                                                                           | <b>THEORY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                          |  |                             | 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 <sub>2</sub> –H <sub>2</sub> O–CaCO <sub>3</sub> 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 <sup>18</sup> O, δ <sup>13</sup> C, (‰ vs. SMOW, PDB), Isotope fractionation and its applications for Paleoclimate. |                                                                                                                                                                                                                          |  |                             |         |    |
| UNIT-III                                                                          | <b>THEORY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                          |  |                             | 15 hrs. |    |
|                                                                                   | Introduction to sedimentary geochemistry: Geochemical processes involved in rock weathering, CO <sub>2</sub> 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, 14C dating, Fission track Dating, Isotope Geochemistry of the Earth's Mantle and crust                                                                                                             |                                                                                                                                                                                                                          |  |                             |         |    |
| UNIT-IV                                                                           | <b>LAB</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                          |  |                             | 30 hrs. |    |
|                                                                                   | Mineral formula calculations, LOI determination, Binary plots of trace elements                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                          |  |                             |         |    |
| <b>REFERENCES</b>                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                          |  |                             |         |    |
| 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>The Maharaja Sayajirao University of Baroda</b><br>Faculty of Science,<br>Department of Geology                                                                                      |  | ACADEMIC<br>YEAR<br>2026-27 |         |
| <b>M.Sc. Geology : Regular (NEP, 2020) (2 Year Programme)</b>                     |                                                                                                     |                                                                                                                                                                                         |  |                             |         |
| YEAR                                                                              | I                                                                                                   | <b>SEC5281C: Geochemistry Lab</b>                                                                                                                                                       |  | 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. |  |                             |         |
| <b>COURSE CONTENT / SYLLABUS</b>                                                  |                                                                                                     |                                                                                                                                                                                         |  |                             |         |
| 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.            |                                                                                                                                                                                         |  |                             |         |
| <b>REFERENCES</b>                                                                 |                                                                                                     |                                                                                                                                                                                         |  |                             |         |
| 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>M.Sc. Geology : Regular (NEP, 2020) (2 Year Programme)</b>                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                       |  |                             |         |
| YEAR                                                                              | I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>GLM5002C: Advanced Paleontology</b>                                                                                                                                                                                                |  | 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. |  |                             |         |
| <b>COURSE CONTENT / SYLLABUS</b>                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                       |  |                             |         |
| UNIT-I                                                                            | <b>THEORY</b><br>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                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                       |  |                             | 15 hrs. |
|                                                                                   | <b>UNIT-II</b><br><b>THEORY</b><br>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<br>Paleoclimate & Paleoenvironmental Reconstruction Fossils as proxies for: Temperature; Oxygen levels; Sea-level change; Stable isotopes (basic introduction) |                                                                                                                                                                                                                                       |  |                             |         |
| UNIT-III                                                                          | <b>LAB</b><br>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)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                       |  |                             | 30 hrs. |
|                                                                                   | <b>UNIT-IV</b><br><b>LAB</b><br>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).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                       |  |                             |         |
| <b>REFERENCES</b>                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                       |  |                             |         |
| 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.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                       |  |                             |         |

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|  |                                                                                                                                                           | <b>The Maharaja Sayajirao University of Baroda</b><br>Faculty of Science,<br>Department of Geology                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  | ACADEMIC<br>YEAR<br>2026-27 |    |
| <b>M.Sc. Geology : Regular (NEP, 2020) (2 Year Programme)</b>                     |                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                             |    |
| YEAR                                                                              | I                                                                                                                                                         | <b>GLM5012C: Landscape Evolution</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |  | 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.                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |                             |    |
| <b>COURSE CONTENT / SYLLABUS</b>                                                  |                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                             |    |
| <b>UNIT-I</b>                                                                     |                                                                                                                                                           | <b>THEORY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |  | 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.                                                                                                                                                                                                                 |  |                             |    |
| <b>UNIT-II</b>                                                                    |                                                                                                                                                           | <b>THEORY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |  | 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. |  |                             |    |
| <b>UNIT-III</b>                                                                   |                                                                                                                                                           | <b>THEORY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |  | 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.                                                                                                                                                                                                                                                                                        |  |                             |    |
| <b>UNIT-IV</b>                                                                    |                                                                                                                                                           | <b>LAB</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |  | 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.                                                                                                                                                                                                                                                                                                                                             |  |                             |    |
| <b>REFERENCES</b>                                                                 |                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                             |    |
| 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 &amp; Planetary Science</i> , 48(9).                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                             |    |
| 7.                                                                                | Wilson, J. P., & Gallant, J. C. (Eds.). (2000). <i>Terrain analysis: principles and applications</i> . John Wiley & Sons.                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                             |    |

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|  |    | The Maharaja Sayajirao University of Baroda<br>Faculty of Science,<br>Department of Geology                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  | ACADEMIC<br>YEAR<br>2026-27 |    |
| M.Sc. Geology : Regular (NEP, 2020) (2 Year Programme)                            |    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |                             |    |
| YEAR                                                                              | I  | GLM5022C: Sequence Stratigraphy and Basin Analysis                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  | CREDIT                      | 4  |
| Semester                                                                          | II |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  | HOURS                       | 75 |
| OBJECTIVES:                                                                       |    | To develop conceptual and practical understanding of sequence stratigraphy, system tracts, stratigraphic surfaces, and sedimentary basin analysis techniques for interpreting depositional history and economic applications.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |  |                             |    |
| COURSE CONTENT / SYLLABUS                                                         |    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |                             |    |
| UNIT-I                                                                            |    | THEORY                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |  | 15 hrs.                     |    |
|                                                                                   |    | Introduction to System tracts: Definition and Stacking Patterns, Economic Potential of HST, FSST, LST, TST, RST, LAST and HAST. Introduction to Sequence Models, Types of Stratigraphic Sequences- Depositional, Genetic and T-R, Parasequence. Sequences in Fluvial, Coastal to Shallow Water Clastic System, Deep-water Clastic System, Carbonate Systems. Concept of Reference Curve for Stratigraphic Surface, hierarchy of Sequence and Sequence boundaries. Sea level changes and Sedimentation. Introduction, scope and development of sequence stratigraphy, Controls on Sequence development, Basic concepts: Accommodation space, base level, allogenic and autogenic controls, Sequence Stratigraphic Framework: Definition and Scales of depositional systems (FSST, LST, TST, HST), system (HAST, LAST). Stratigraphic sequences (Depositional, Genetic, Transgressive-regressive). Surfaces: Types and Characteristics. Hierarchy and cycles in sequence stratigraphy, Model dependent and independent hierarchy. |  |                             |    |
| UNIT-II                                                                           |    | THEORY                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |  | 15 hrs.                     |    |
|                                                                                   |    | Historical Development of Sequence Stratigraphy. Methods: Facies analysis through Outcrop, Core and Modern analogues, Well Logs, Seismic data. Workflow of analysis. Allogenic Controls on Sedimentation, Sediment Supply and Energy Flux, Sediment Accommodation, Shoreline Trajectories. Stratigraphic Surfaces: Introduction, Types of stratal terminations, Definitions and characteristics- Subaerial Unconformity, Correlative Conformity, Basal Surface of Forced Regression, Regressive Surface of Marine Erosion, Maximum Regressive Surface, Maximum Flooding Surface, Transgressive Ravinement Surfaces- Wave-Ravinement Surface, Tidal-Ravinement Surface, Within trend facies contacts- Within-trend Normal Regressive Surface, Within-trend Forced Regressive Surface, Within-trend Flooding Surface.                                                                                                                                                                                                             |  |                             |    |
| UNIT-III                                                                          |    | THEORY                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |  | 15 hrs.                     |    |
|                                                                                   |    | 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.                                                                                                                                                                                                                                                                                                                                                                                                         |  |                             |    |
| UNIT-IV                                                                           |    | LAB                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |  | 30 hrs.                     |    |
|                                                                                   |    | Practicals related Facies analysis, facies association and depositional systems, walther’s law. Delineation and interpretation of Stratigraphic Surfaces and system tracts from outcrop, well log and seismic data.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |  |                             |    |
| REFERENCES                                                                        |    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |                             |    |
| 1.                                                                                |    | Principles of sedimentary basin analysis: A.D.Miall (1999), Springer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |  |                             |    |
| 2.                                                                                |    | Sequence Stratigraphy: D. Emery, and K. Meyers (1996) Blackwell Publishers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |                             |    |
| 3.                                                                                |    | Principles of Sequence Stratigraphy: Octavian cateneauau (2006) Elsevier                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                             |    |
| 4.                                                                                |    | Basin Analysis: Principles and Applications: P.A. Allen and J.R.Allen (1990) Blackwell Publishing                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |                             |    |
| 5.                                                                                |    | The geology of stratigraphic sequences: A.D. Miall (1997) Springer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |                             |    |

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|  | <b>The Maharaja Sayajirao University of Baroda</b><br>Faculty of Science,<br>Department of Geology                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                     |  | ACADEMIC<br>YEAR<br>2026-27 |         |    |
| <b>M.Sc. Geology : Regular (NEP, 2020) (2 Year Programme)</b>                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                     |  |                             |         |    |
| YEAR                                                                              | I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>GLM5032C: Structural Analyses of Rocks</b>                                                                                                                                                                                       |  |                             | 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. |  |                             |         |    |
| <b>COURSE CONTENT / SYLLABUS</b>                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                     |  |                             |         |    |
| UNIT-I                                                                            | <b>THEORY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                     |  |                             | 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<br>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                                                                           | <b>THEORY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                     |  |                             | 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.<br>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                                                                          | <b>THEORY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                     |  |                             | 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                                                                           | <b>LAB</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                     |  |                             | 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.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                     |  |                             |         |    |
| <b>REFERENCES</b>                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                     |  |                             |         |    |
| 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>The Maharaja Sayajirao University of Baroda</b><br>Faculty of Science,<br>Department of Geology                                                                                                                          |  | ACADEMIC<br>YEAR<br>2026-27 |         |
| <b>M.Sc. Geology: Regular (NEP, 2020) (2 Year Programme)</b>                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                             |  |                             |         |
| YEAR                                                                              | I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>GLM5042C: Crustal Evolution of Indian Plate</b>                                                                                                                                                                          |  | CREDIT                      | 4       |
| Semester                                                                          | II                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                             |  | HOURS                       | 60      |
| OBJECTIVES:                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | To develop an integrated understanding of plate tectonic processes, paleomagnetic techniques, and the crustal evolution of Indian cratons, mobile belts, sedimentary basins, and Himalayan orogeny through geological time. |  |                             |         |
| <b>COURSE CONTENT / SYLLABUS</b>                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                             |  |                             |         |
| UNIT-I                                                                            | <b>THEORY</b><br>Plate motions and driving mechanism of tectonic plates; Paleomagnetism and polar wander path and various other tools for determination of plate motion; Tectonic framework of India Plate: Cratons, Mobile belts and shear zones, Lineaments and tectonic boundaries; Archean crust formation, Tonalite-Trondhjemite-Gneiss suites and tectonic significance of greenstone belts; Archean Craton in southern India: Western v/s eastern Dharwar craton, Komatiite bearing sequences and their mantle temperature implication, Closepet granite and shear zones, isotopic geochronological framework and mineral assets. |                                                                                                                                                                                                                             |  |                             | 15 hrs. |
|                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                             |  |                             |         |
| UNIT-II                                                                           | <b>THEORY</b><br>Archean cratons of central, eastern and western India: Crustal evolution of Singhbhum craton, deposition of BIF, Singhbhum shear zones, kinematics and metallogenesis; Craton nucleation, deformation pattern and evolution of the Bastar craton; Banded Gneissic complex, Aravalli and Delhi Supergroup stratigraphy and basin evolution, transition from passive margin to collision orogen, shear zones and mineralization; Proterozoic mobile belts of India: evidences and significance of high grade metamorphism, correlation with ancient orogenies and reconstruction of paleo supercontinents.                |                                                                                                                                                                                                                             |  |                             | 15 hrs. |
|                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                             |  |                             |         |
| UNIT-III                                                                          | <b>THEORY</b><br>Proterozoic basin evolution, stratigraphy and mineralization: Intracratonic basins ( Vindhayan, Cuddapah, Kaladgi Bhima, and other basins of peninsular India) and rift basins ( Narmada, Pranhita-Godavari); Assembly with Gondwana: sedimentation and tectonic framework of Gondwana basins, Break-up of Gondwana: Initial rifting, plate motion of India after breakup; Deccan volcanic province: Plume tectonics and large igneous province emplacement; off-shore sedimentary basins (Krishna-Godavari and Mumbai offshore).                                                                                       |                                                                                                                                                                                                                             |  |                             | 15 hrs. |
|                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                             |  |                             |         |
| UNIT-IV                                                                           | <b>THEORY</b><br>Marine transgression and development, tectonics and stratigraphy of Mesozoic basins (Spiti-Gondwana-Jaisalmer-Kachchh and other basins across the India); Himalayan Orogeny - Phases and tectonic zones, major thrust systems, foreland basin development, granitoids of Himalayan evolution and Siwalik sedimentation; Indian plate collision, its effects and development of various Paleogene-Neogene basins across the Indian subcontinent; Magmatic activities across the Indian plate.                                                                                                                            |                                                                                                                                                                                                                             |  |                             | 15 hrs. |
|                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                             |  |                             |         |
| <b>REFERENCES</b>                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                             |  |                             |         |
| 1.                                                                                | Kearey, P., Klepeis, K. A., & Vine, F. J. (2009). <i>Global tectonics</i> . John Wiley & Sons. Oxford                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                             |  |                             |         |
| 2.                                                                                | Ramakrishnan, M., &Vaidyanadhan, R. (2008). <i>Geology of India</i> (Vol 1 and 2), Geological Society of India.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                             |  |                             |         |
| 3.                                                                                | Valdiya, K. S. (2010) <i>The making of India</i> , Macmillan India Pvt. Ltd                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                             |  |                             |         |
| 4.                                                                                | Sharma, R. (2009). <i>Cratons and fold belts of India</i> (Vol. 127). Springer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                             |  |                             |         |
| 5.                                                                                | RamakrishnanM., &Vaidyanadhan, R. (2008). <i>Geology of India</i> (Vol 1 and 2), Geological Society of India.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                             |  |                             |         |
| 6.                                                                                | Krishnan, M. S. (1982) <i>Geology of India and Burma</i> , CBS Publishers, Delhi                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                             |  |                             |         |

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| <b>M.Sc. Geology: Regular (NEP, 2020) (2 Year Programme)</b>                      |                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                     |  |                             |         |    |
| YEAR                                                                              | I                                                                                                                                                                                                                                                                                                      | <b>SEC 5282C: Outdoor Practical in Geology</b>                                                                                                                                                      |  |                             | CREDIT  | 2  |
| Semester                                                                          | II                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                     |  |                             | HOURS   | 60 |
| OBJECTIVES:                                                                       |                                                                                                                                                                                                                                                                                                        | To develop field-based skills in identifying igneous, sedimentary, and metamorphic terrains, structural analysis, stratigraphic interpretation, and applications in mining and engineering geology. |  |                             |         |    |
| <b>COURSE CONTENT / SYLLABUS</b>                                                  |                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                     |  |                             |         |    |
| SEC                                                                               | LAB                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                     |  |                             | 60 hrs. |    |
|                                                                                   | Outdoor practical in Igneous, Sedimentary and Metamorphic terrains. Structural analyses of rocks. Studies of stratigraphic successions and fossil record. Studies of engineering structures with reference to geosciences. Understanding aspects of mining geology, Studies of geological marvels etc. |                                                                                                                                                                                                     |  |                             |         |    |
| <b>REFERENCES</b>                                                                 |                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                     |  |                             |         |    |
| 1.                                                                                | Compton, R. R., & Compton, R. R. (1985). <i>Geology in the Field</i> (p. 416). New York: Wiley.                                                                                                                                                                                                        |                                                                                                                                                                                                     |  |                             |         |    |
| 2.                                                                                | Field Geology, Frederic Henry Lahee, Publisher McGraw-Hill Book Company, 1961                                                                                                                                                                                                                          |                                                                                                                                                                                                     |  |                             |         |    |