Sardar Patel University, Mandi (H.P.) - 175001

[Established Under H. P. Legislative Assembly Act 03 of 2022 | Recognized Under Section 2(f) - UGC Act 1956]

Scheme & Syllabi of Bachelor of Science

3-years and 4-years (Honours / Honours with Research)

in Geology

[Three Years/ Four Years Undergraduate Programme] Based on NEP 2020

Effective from Academic Session 2026-27 Onwards

1. Institutional Program Framework

Program Educational Objectives (PEOs)

The Program Educational Objectives enable undergraduate students to:

- **PEO-1:**Develop a strong foundation in geological sciences through the study of minerals, rocks, earth processes, structures, stratigraphy, and geomorphology.
- **PEO-2:**Develop practical skills in geological field mapping, mineral and rock identification, laboratory techniques, and geospatial applications.
- **PEO-3:**Foster scientific reasoning, effective communication, teamwork, and professional ethics in geological investigations and related activities.
- **PEO-4:**Prepare students for higher education, research, government services, industry, and professional careers in geosciences and allied fields.
- **PEO-5:**Promote lifelong learning, sustainable resource management, and awareness of environmental and geological hazards.

Program Specific Outcomes (PSOs)

The B.Sc. (Honours with Research) in Geology curriculum is strategically targeted to help students:

- **PSO-1:**Apply principles of mineralogy, petrology, structural geology, stratigraphy, and geomorphology to understand geological processes and Earth history.
- **PSO-2:**Demonstrate practical skills in geological mapping, mineral and rock identification, topographic map interpretation, and laboratory analysis.
- **PSO-3:**Utilize geological maps, remote sensing data, GIS tools, and field observations for solving geological problems.
- **PSO-4:**Assess geological hazards, groundwater resources, and environmental issues using appropriate geological methods.
- **PSO-5:**Design and undertake basic geological research projects following scientific methods and ethical practices.

Program Outcomes (POs)

Upon satisfactory fulfillment of the undergraduate curriculum track, students demonstrate complete mastery across the following professional outcome lines:

- **PO1:Disciplinary Knowledge:** Demonstrate comprehensive knowledge of minerals, rocks, structures, fossils, stratigraphy, geomorphology, and Earth processes.
- **PO2: Critical Thinking and Problem Solving:**Apply scientific reasoning and geological principles to analyze and solve geological problems.
- **PO3: Research Competency:**Conduct basic geological investigations, collect data, interpret results, and prepare scientific reports.
- **PO4: Practical and Technical Skills:**Demonstrate proficiency in geological fieldwork, laboratory techniques, map interpretation, and instrument handling
- **PO5: Environmental and Sustainability Awareness:**Understand sustainable utilization of natural resources and environmental conservation practices.
- **PO6: Digital and Technological Competence:**Apply GIS, remote sensing, computer applications, and digital tools in geological studies.
- **PO7: Communication Skills:**Communicate geological information effectively through reports, presentations, maps, and scientific discussions.

- **PO8: Ethics and Professional Responsibility:**Demonstrate ethical conduct, professional responsibility, and adherence to safety standards.
- **PO9: Leadership and Teamwork:**Work effectively as an individual and as a member or leader of multidisciplinary teams.
- **PO10: Lifelong Learning:**Recognize the need for continuous learning and professional development in geosciences.
- **PO11: Multidisciplinary Integration:**Integrate geological knowledge with environmental, engineering, and societal applications.
- **PO12: Employability and Entrepreneurship:**Develop skills required for employment, entrepreneurship, and professional growth in geosciences and related sectors.

2. Semester-wise Credit Breakdown Matrix

The multi-entry and multi-exit structure across the four years of the undergraduate program complies strictly with the following credit parameters:

Course Type / Sem	DSC	DSE	MDC	SEC	AEC	VAC	INP/APT/PRT	DIS	Total Credits
I	12	-	3	3	2	-	-	-	**20**
II	12	-	3	3	-	2	4	-	**24**
Exit Option: Award of Undergraduate Certificate after securing 44 credits with 4 credits of I/A/P/C during winter/summer term									
III	8 (MJ) + 4 (MN)	-	3	3	2	2	-	-	**22**
IV	8 (MJ) + 4 (MN)	4	-	-	2	2	-	-	**20**
Exit Option: Award of Undergraduate Diploma after securing 86 credits along with re-entry options									
V	8 (MJ) + 4 (MN)	8	-	-	2	-	-	-	**22**
VI	8 (MJ) + 4 (MN)	8	-	-	-	-	-	-	**20**
Exit Option: Award of 3-Year Bachelor's Degree after completion of 128 cumulative credits									
VII	12 (MJ)	4	-	-	-	-	-	4	**20**
VIII	8 (MJ)	4	-	-	-	-	-	8	**20**
Total Credits	**92 (76MJ+ 16MN)**	**28**	**9**	**9**	**8**	**6**	**4**	**12**	**168 Credits**

Abbreviations Used: DSC: Discipline Specific Core; DSE: Discipline Specific Elective; MDC: Multidisciplinary Course; SEC: Skill Enhancement Course; AEC: Ability Enhancement Course; VAC: Value Added Course; MJ: Major Track; MN: Minor Track; INP/APT/PRT/COM: Internship/Apprenticeship/Project/Community Outreach; DIS: Dissertation Track.

3. Curricular Schemes: Semesters I & II

To align with the SPU Mandi guidelines as per NEP-2020, all 4-credit geology core courses are expanded explicitly into distinct Theory (3 Credits, 75 marks) and Practical (1 Credit, 25 marks) structural rows.

Semester I Scheme Table

S.No.	Course Code	Course Title	Category	L	T	P	C	CH	Theory Marks		Practical Marks		Total Marks
									IA	ESE	IA	ESE	Total Marks
1	BGEOL-DSC-101 T	Fundamentals of Geology (T)	DSC	3	0	0	3	3	25	50	-	-	**75**
2	BGEOL-DSC-101 P	Fundamentals of Geology (P)	DSC	0	0	1	1	2	-	-	5	20	**25**
3	BXXXX-DSC-101 T	Second Core Stream Subject - Paper I (T)	DSC	3	0	0	3	3	25	50	-	-	**75**
4	BXXXX-DSC-101 P	Second Core Stream Subject - Paper I (P)	DSC	0	0	1	1	2	-	-	5	20	**25**
5	BYYYY-DSC-101 T	Third Core Stream Subject - Paper I (T)	DSC	3	0	0	3	3	25	50	-	-	**75**
6	BYYYY-DSC-101 P	Third Core Stream Subject - Paper I (P)	DSC	0	0	1	1	2	-	-	5	20	**25**
7	BGEOL-MDC-101	Understanding Planet Earth (T)	MDC	3	0	0	3	3	25	50	-	-	**75**
8	BGEOL-SEC-101	Historical Geology & Geological Time Scale	SEC	3	0	0	3	3	25	50	-	-	**75**
9	BXXX-AEC-101	Ability Enhancement Course I	AEC	2	0	0	2	2	15	35	-	-	**50**
Total / Cumulative Track Performance				**17**	**0**	**3**	**20**	**23**	**Theory Exam Total: 425**		**Practical Total: 75**		**500**

Semester II Scheme Table

S.No.	Course Code	Course Title	Category	L	T	P	C	CH	Theory Marks		Practical Marks		Total Marks
									IA	ESE	IA	ESE	Total Marks
1	BGEOL-DSC-201 T	Introduction to Mineralogy (T)	DSC	3	0	0	3	3	25	50	-	-	**75**
2	BGEOL-DSC-201 P	Introduction to Mineralogy (P)	DSC	0	0	1	1	2	-	-	5	20	**25**
3	BXXXX-DSC-201 T	Second Core Stream Subject - Paper II (T)	DSC	3	0	0	3	3	25	50	-	-	**75**
4	BXXXX-DSC-201 P	Second Core Stream Subject - Paper II (P)	DSC	0	0	1	1	2	-	-	5	20	**25**
5	BYYYY-DSC-201 T	Third Core Stream Subject - Paper II (T)	DSC	3	0	0	3	3	25	50	-	-	**75**
6	BYYYY-DSC-201 P	Third Core Stream Subject - Paper II (P)	DSC	0	0	1	1	2	-	-	5	20	**25**
7	BGEOL-MDC-201	Environmental Hazards and Society (T)	MDC	3	0	0	3	3	25	50	-	-	**75**
8	BGEOL-SEC-201	Geomorphology (T)	SEC	3	0	0	3	3	25	50	-	-	**75**
9	BXXXX-VAC-101	Value Addition Course I	VAC	2	0	0	2	2	15	35	-	-	**50**
10	BGEOL-IAPC-201	Field-Based Internship / Project	INP	4	0	0	4	12	100% Comprehensive Internal Evaluation		-	-	**100**
Total / Cumulative Term Performance				**21**	**0**	**3**	**24**	**35**	**Theory Exam Total: 425**		**Practical / Internship: 175**		**600**

4. Semester I Syllabi

Course Code: BGEOL-DSC-101 T | Course Title: Fundamentals of Geology (Theory)

L: 3 | T: 0 | P: 0 | C: 3 Credits | CH: 45 Hours | Course Type: Discipline Specific Core
Prerequisite: Completion of 10+2 or equivalent examination.

i. Course Objectives:

1. To introduce the fundamental definition, history, major sub-branches, and scientific scope of geological sciences.
2. To provide an understanding of the origin, evolution, and internal structure of the Earth.
3. To understand earthquakes, volcanoes, and plate tectonic processes.

ii. Course Outcomes: Upon completion of this course, students are expected to:

- **CO1:** Detail the applications, branches, and cross-disciplinary scope of modern geological frameworks.
- **CO2:** Describe the planetary accretion, core differentiation, and internal physical structure of the Earth.
- **CO3:** Explain macro volcanic eruption classes, earthquakes, and hazard monitoring indicators.
- **CO4:** Synthesize theories of continental drift, sea-floor spreading mechanisms, and plate boundaries.

iii. Syllabus Matrix:

Section	Contents and Detailed Topic Breakdown	Contact Hours
Section 1	**Origin and Evolution of the Earth** Introduction to Geology: Definition, scope of Geology, Branches of Geology and its relationship with other sciences, Importance of Geology in Human Civilization. Universe, Origin of the Solar System, Accretion Model, Differentiation of Core, Mantle and Crust. Age of the Earth, Methods of determination of age (brief idea); Concept of Geological Time Scale.	15 Hours
Section 2	**Earth as a Planet and its Internal Structure** Internal Structure of the Earth: Evidences from Seismic waves, Evidence from Meteorites, Direct Petrological evidences. Earth's Chemical Composition. Thermal Field of the Earth: Solar radiation; Temperature change below the Earth. Earth's Magnetic Field: Nature of magnetic field, Palaeomagnetism & Polarity Reversals.	15 Hours
Section 3	**Internal Dynamic Processes and Global Tectonics** Volcanoes: General features, Products of Volcanoes, types of volcanoes, types of eruption based on Degree of Violence, Geographical Distribution, Prediction of volcanism, Past volcanism of India. Earthquakes: General features, seismic waves, Record of Seismic waves and locating an Epicentre, Intensity and Magnitude,	15 Hours

Section	Contents and Detailed Topic Breakdown	Contact Hours
	Geographical Distribution, Causes, Monitoring and assessment of earthquake hazards, Seismicity in India. Global Tectonics: Continental Drift, Theory of Seafloor Spreading, Plate Tectonics; Plate boundaries: Divergent, Convergent and Transform Margins.	

iv. Suggested Readings:

- Dutta, A.K. (2021). *Introduction to Physical Geology*, Kalyani Publishers.
- Tarbuck, E. J., Lutgens, F. K., & Tasa, D. (2017). *Earth: An Introduction to Physical Geology*, 12th Edition. Pearson.
- Dasgupta, Amal (2025). *An Introduction to Earth Science, Part I: Physical Geology*.

v. Evaluation Pattern:

- Continuous Comprehensive Evaluation (CCE) Internal: 25 Marks
- Semester End Theory Examination (ESE): 50 Marks
- Total Course Portfolio Credit Weight: 75 Marks

vi. Components of Internal Evaluation:

1. Written Assignments & Classroom Technical Presentations: 10 Marks
2. Mid-Term/House Examination Review Paper: 10 Marks
3. Attendance Maintenance Component: 5 Marks (75%-79.9%: 1; 80%-84.9%: 2; 85%-89.9%: 3; 90%-94.9%: 4; 95%-100%: 5)

vii. Instructions for the Paper Setter:

Mid-Semester Examination: Maximum Marks: 10. Consists of compulsory short-answer questions from topics covered up to 50% of the syllabus.

End-Semester Examination (50 Marks Total): Portfolio contains 16 total questions across Parts A, B, C, and D.

- **Part A (Section I):** Contains 2 analytical conceptual questions. The student must attempt any 1 question (12 Marks).
- **Part B (Section II):** Contains 2 analytical conceptual questions. The student must attempt any 1 question (12 Marks).
- **Part C (Section III):** Contains 2 analytical conceptual questions. The student must attempt any 1 question (12 Marks).
- **Part D (All Sections):** Contains 10 Short-Answer questions distributed across all units. The student must attempt any 7 questions (2 Marks each = 14 Marks).

viii. Pass requirement: Minimum 35% separately in Internal Assessment and End Semester Examination, and 40% in aggregate, as per University regulations.

Course Code: BGEOL-DSC-101 P | Course Title: Fundamentals of Geology (Practical)

L: 0 | T: 0 | P: 1 | C: 1 Credit | CH: 30 Hours | Course Type: Discipline Specific Core
Prerequisite: Completion of 10+2 or equivalent examination.

i. Course Objectives: To enable undergraduate students to use basic geological field equipment, decipher topographic maps contour parameters, draw topographic profiles, plot global plate boundaries, and macroscopically classify core earth materials.

ii. Course Outcomes: Upon completion of this practical block, students are expected to:

- **CO1:** Handle structural clinometers, geological hammers, and scale grids on topographic sheets.
- **CO2:** Interpret relief patterns, profile sections, and layout shapes from contour patterns.
- **CO3:** Plot volcanic belts, deep oceanic trenches, and categorize primary rock hand-specimens.

iii. Syllabus (List of Laboratory Experiments):
1.Introduction to basic geological tools and handling (Geological hammer, Clinometer compass, field notebook).
2.Reading scale lines, coordinates, margins, map orientations, and standard cultural symbols on topographic maps.
3.Reading contour layouts to identify isolated hills, valleys, uniform slopes, spurs, and closed depressions.
4.Construction of simple topographic profiles and graphic cross-sections across standard contour features.
5.Spatial plotting exercises mapping the global geographic layout of primary plate borders, oceanic trenches, and island arcs.
6.Mapping active seismic epicenters and circum-Pacific volcanic chains on base world maps.
7.Macroscopic hand-specimen sorting and identificationof basic earth materials into primary Igneous classes.
8.Macroscopic hand-specimen sorting and identificationof basic earth materials into primary Sedimentary classes.
9.Macroscopic hand-specimen sorting and identificationof basic earth materials into primary Metamorphic classes.
10.Structural tracing and spatial observation of elementary folds and faults on laboratory block models.
11.Identification of dip, strike and outcrop patterns using simple block diagrams.
12. Introduction to common rock-forming minerals and rocks. (Minerals: Quartz, Feldspar, Mica; Rocks: Granite, Basalt, Sandstone, Limestone).

Field Component: Field visit to a nearby geological exposure, geomorphic feature, mineral occurrence, or other relevant site may be conducted wherever feasible.

iv. Evaluation Pattern: Continuous Lab Internal Evaluation: 5 Marks | End Semester Laboratory Practical Examination: 20 Marks | Total Course Marks: 25 Marks.

v. Components of Internal Evaluation: Practical Notebook Upkeep: 2 Marks | Continuous Performance: 3 Marks.

vi. End-Semester Practical Exam Breakdown: Experiment Performance: 10 Marks | Viva-Voce: 5 Marks | Practical File Verification: 5 Marks.

Course Code: BGEOL-MDC-101 | Course Title: Understanding Planet Earth

L: 3 | T: 0 | P: 0 | C: 3 Credits | CH: 45 Hours | Course Type: Multidisciplinary Course
Prerequisite: None.

i. Course Objectives: Introduce students to Earth systems, rock category cycles, subsurface water resources overview, and highlight geoscientific alignment within civil engineering infrastructure.

ii. Course Outcomes: Upon completion of this course, students are expected to:

- **CO1:** Detail basic planetary layouts, core concentric boundaries, and cosmic solar origins.
- **CO2:** Identify daily rock-forming mineral classes and define the overarching Rock Cycle framework.
- **CO3:** Correlate earth material distributions with national infrastructure works and watershed configurations.

iii. Syllabus Matrix:

Section	Contents and Detailed Topic Breakdown	Contact Hours
Section 1	**Planet Earth in Space and Time** Introduction to Geology: Definition, scope, primary branches, and its interdisciplinary relationship with other sciences. General characteristics and origin of the Universe, Solar System, and planets. Evolution of Earth: Brief idea regarding the origin of Earth and Solar System; scientific estimation of Earth's age. Internal structural layers of the Earth: Crust, Mantle, and Core. Brief parameters of the Atmosphere, Hydrosphere, and Biosphere. Earth as a unique habitable planet and conditions necessary for life.	15 Hours
Section 2	**Earth Materials and Dynamic Cycles** Definition and basic concept of Minerals as natural building blocks of rocks. Physical properties of minerals: color, streak, luster, and hardness (Mohs Scale). Introduction to common minerals used in everyday life (Quartz, Feldspar and Mica). Classification of Rocks: Igneous, Sedimentary, and Metamorphic classes. Definition, processes of formation, and examples of each primary rock type. Concepts of the Rock Cycle.	15 Hours
Section 3	**Earth Resources, Infrastructure, and Society** Introduction to Natural Resources: Renewable and Non-renewable energy resources. Basic introduction to Minerals and metals important for daily life, industry and national development. Groundwater: Subsurface occurrence, water table distribution, and introduction to aquifers. Importance of groundwater and water conservation. Brief overview of major physiographic divisions of India. Role of geological investigations in key human engineering projects (Dams, Reservoirs, Tunnels, and Bridges).	15 Hours

iv. Evaluation Pattern: Internal Assessment: 25 Marks | End Semester Written Theory Exam: 50 Marks | Total: 75 Marks. (Internal metrics split across Attendance [5], Assignments [10], and House test [10]). Pass requirement: Minimum 35% separately in Internal Assessment and End Semester Examination, and 40% in aggregate, as per University regulations.

Course Code: BGEOL-SEC-101 | Course Title: Historical Geology & the Geological Time Scale

L: 3 | T: 0 | P: 0 | C: 3 Credits | CH: 45 Hours | Course Type: Skill Enhancement Course
Prerequisite: Completion of 10+2 or equivalent examination.

i. Course Objectives: Deliver deep insights into baseline laws of stratigraphy, relative geochronological dating structures, atmosphere evolution models, and trace core evolutionary stages of organisms across geological eras.

ii. Course Outcomes: Upon completion of this course, students are expected to:

- **CO1:** Apply laws of superposition, original horizontality, and faunal succession to evaluate lithology logs.
- **CO2:**Differentiate lithostratigraphic, biostratigraphic, and chronostratigraphic units and apply them in stratigraphic correlation.
- **CO3:** Discuss prebiotic planet evolution, historic oxygen enrichment records, and early hydrosphere developments.
- **CO4:**Explain the major stages in the evolution of life from early organisms to humans in relation to the Geological Time Scale.

iii. Syllabus Details:

Section	Contents	Contact Hours
1	**Foundations of Stratigraphy and Geological Time** Scope of Study; Geological Time and Time Scale; Stratigraphic Units; Stratigraphic Column. Some fundamental Principles in Stratigraphic Study: Principle of Uniformitarianism, Steno's law of Superposition, law of Faunal Succession, Principle of Original Horizontality, Principle of Lateral Continuity. Evolution of Atmosphere; Evolution of Oxygen in Atmosphere; Evolution of Hydrosphere. Relative Dating Methods: Superposition, Cross-cutting Relationship and Unconformities.	15 Hours
2	**Sedimentary Environments, Geological Time and Major Geological Provinces of India** Sedimentary Environments: elements and Types of Environments; Measurement of Geological Time. Introduction to Lithostratigraphy, Biostratigraphy and Chronostratigraphy. Stratigraphic Correlation: Physical and Palaeontological Methods; Major Geological Provinces of India and Indian Stratigraphic Column. Interpretation of simple stratigraphic columns and geological time charts.	15 Hours

Section	Contents	Contact Hours
3	**History of Life Through Geological Time** Origin of life and major stages in the development of life on Earth. Major evolutionary milestones in the history of plants, invertebrates and vertebrates, including the emergence of mammals and humans, with reference to the Geological Time Scale.	15 Hours

iv. Evaluation Pattern: Internal Assessment: 25 Marks | End Term University Exam: 50 Marks | Total: 75 Marks. *Pass requirement: Minimum 35% separately in Internal Assessment and End Semester Examination, and 40% in aggregate, as per University regulations.*

5. Semester II Syllabi

Course Code: BGEOL-DSC-201 T | Course Title: Introduction to Mineralogy (Theory)

L: 3 | T: 0 | P: 0 | C: 3 Credits | CH: 45 Hours | Course Type: Discipline Specific Core
Prerequisite: Successful completion of BGEOL-DSC-101.

i. Course Objectives: Define mechanical crystal traits, silicates atomic classifications, polarized wave properties, and inspection modelsof polarizing petrological microscopes.

ii. Course Outcomes: Upon completion of this course, students are expected to:

- **CO1:** Differentiate physical, chemical, and micro-optical mineral inspection models clearly.
- **CO2:** Correlate coordination polyhedra numbers and silicate framework polymerization types with mineral habits.
- **CO3:** Identify systematic diagnostic parameters for major rock-forming mineral groups.
- **CO4:**Explain optical properties of minerals and interpret interference colours and extinction characteristics under the polarizing microscope.

iii. Syllabus Matrix:

Section	Contents and Detailed Topic Breakdown	Contact Hours
Section 1	**Introduction, Crystal Chemistry, and Microscope Principles** Definition and scope of study of Mineralogy. A General Account of Minerals: Definition of a Mineral; Crystal, crystalline, crypto-crystalline, and amorphous minerals. Crystal forms and habits. Relationship between crystal structure and physical properties of minerals. Classification of Minerals based on various factors; Dana's classification. Various types of study of minerals (Physical vs. Optical vs. Chemical methods). Atomic Structure of Minerals: Ionic crystals, Coordination Number; Silicate Structures. The Petrological Polarizing Microscope: Optical construction, mechanical components, and underlying working principles.	15 Hours
Section 2	**Physical, Chemical, and Systematic Mineralogy** Form and Habit, Cleavage and fracture, Hardness, Specific Gravity, Colour, Streak, and Lustre. Mineral Chemistry: Isomorphism, Polymorphism, and Pseudomorphism. Systematic Mineralogy: Physical, chemical and diagnostic optical properties, geologic occurrence and industrial uses of the following groups of rock-forming minerals: Quartz Group, Feldspar Group, Feldspathoids, Olivine Group, Pyroxene Group, Amphibole Group, Mica Group, Carbonate Group (Calcite and Dolomite), Garnet Group.	15 Hours
Section 3	**Wave Optics and Optical Mineralogy** Nature of light propagation: Polarised and Non-Polarised Light. Optical phenomena in minerals: Double Refraction, Isotropic and Anisotropic Minerals. Mechanical optical components: Nicol Prism, sub-stage assemblies, and retardation plates. Diagnostic micro-optical behaviors:	15 Hours

Section	Contents and Detailed Topic Breakdown	Contact Hours
	Pleochroism and Absorption Colour, Refractive Index of a Mineral, Relief, and Becke Line tracking. Interference of light: Birefringence colors, orders of interference, use of the Quartz wedge, Extinction styles, and calculation of the Extinction Angle.	

iv. Suggested Readings:

- Perkins, D. (2019). *Mineralogy*, 4th Edition. Pearson.
- Deer, W. A., Howie, R. A., & Zussman, J. (1992). *An Introduction to the Rock-Forming Minerals*, 2nd Edition. Longman.
- Klein, C., & Dutrow, B. (2007). *Manual of Mineral Science*, 23rd Edition. Wiley.
- Dasgupta, Amal (2025). *An Introduction to Earth Science, Part II: Mineralogy*.

v. Evaluation Pattern: Internal Assessment Marks: 25 | Semester End University Exam Weight: 50 Marks | Total Course Marks: 75 Marks. Mid-term paper rules and end-semester blueprint layouts match Section 4 (`BGEOL-DSC-101 T`) guidelines identically.

Course Code: BGEOL-DSC-201 P | Course Title: Introduction to Mineralogy (Practical)

L: 0 | T: 0 | P: 1 | C: 1 Credit | CH: 30 Hours | Course Type: Discipline Specific Core
Prerequisite: Sound chemistry and physics understanding acquired up to the 10+2 qualification level.

i. Course Objectives: Build practical hand-specimen verification skills for minerals, operate a polarizing microscope, and identify thin-section micro-optical variables systematically.

ii. Course Outcomes: Upon completion of this practical block, students are expected to:

- **CO1:** Diagnose major mineral habits, cleavage systems, hardness rankings, and streak markings macroscopically.
- **CO2:** Align objective lenses and operate cross-nicols assemblies on laboratory microscopes.
- **CO3:** Track Becke lines, identify pleochroic transformations, and document mineral extinction styles.

iii. Syllabus (List of Laboratory Experiments):

1.Megascopic study of crystal forms and mineral habits. Identification of common habits such as acicular, bladed, fibrous, tabular, prismatic, granular, and massive forms.
2.Hands-on validation testing of mineral mechanical properties: hardness testing using Mohs Hardness Scale criteria, cleavage traces, and fracture types.
3.Hand specimen testing of optical traits: true mineral color determination, streak logging, and identification of luster configurations.
4.Megascopic classification and systematic property profiling of the Feldspar group (Orthoclase, Plagioclase varieties) and Quartz group species.
5.Megascopic classification and systematic property profiling of the Pyroxene group (Augite), Amphibole group (Hornblende), and Olivine specimens.
6.Megascopic classification and systematic property profiling of the Mica family (Muscovite, Biotite) and Feldspathoid groupings.
7.Megascopic classification and diagnostic logging of important carbonate and accessory minerals (Calcite, Dolomite, Gypsum, Tourmaline, and Garnet).
8.Structural alignment and tracking of the components of a petrological polarizing microscope (stage rotation, objective centering, cross-hairs focusing).
9.Microscopic thin-section observation of mineral behavior under plane-polarized light (identifying relief boundaries, cleavage networks, and pleochroic schemes).
10.Microscopic thin-section observation of mineral behavior under crossed nicols (differentiating isotropic vs anisotropic domains, interference orders, and extinction angles).
11.Identification of minerals using: Hardness, Cleavage, Streak, Lustre, Specific gravity.

Field Component: Field visit to a nearby geological exposure, geomorphic feature, mineral occurrence, or other relevant site may be conducted wherever feasible.

iv. Evaluation Pattern: Continuous Lab Book Marking: 2 Marks | Lab Performance: 3 Marks | Final Practical Exam: 20 Marks (comprising 10 Marks Lab performance, 5 Marks Viva, 5 Marks Record check).

Course Code: BGEOL-MDC-201 | Course Title: Environmental Hazards and Society

L: 3 | T: 0 | P: 0 | C: 3 Credits | CH: 45 Hours | Course Type: Multidisciplinary Course
Prerequisite: None.

i. **Course Objectives:** Categorize natural vs human-induced surface risks, explore flood or landslide trigger systems, study Himalayan risk profiles, and examine localized disaster management steps.

ii. **Course Outcomes:** Upon completion of this course, students are expected to:

- **CO1:** Differentiate basic hazard indices, disaster criteria, risk factors, and vulnerability parameters.
- **CO2:** Discuss seismic patterns, cloudburst dynamics, and regional flash-flooding mechanisms across India.
- **CO3:** Draft local preparedness plans, community warning frameworks, and post-disaster response loops.

iii. Syllabus Matrix:

Section	Contents and Detailed Topic Breakdown	Contact Hours
Section 1	**Foundations of Earth Hazards and Seismicity** Introduction to Environmental Hazards: Definition, scope, and basic terms (Hazard, Risk, Disaster, Vulnerability). Internal and external Earth processes responsible for natural hazards. Earthquakes: causes, parameters, measuring scales (intensity and magnitude), seismic hazards, and Major earthquake-prone regions of the world and India. Volcanoes: primary eruptive types, volcanic products, environmental effects, and geographic distribution.	15 Hours
Section 2	**Surficial and Hydro-Meteorological Disasters** Mass Wasting and Surface Failures: Landslides, mudflows, rockfalls, and soil creep (Causes and impacts). Flood-related hazards: Fluvial flooding, cloudburst events, changing urban drainage patterns, and river system failures. Glacial and mountain hazards: Snow avalanches and Glacial Lake Outburst Floods (GLOFs) with reference to the Himalayan region. Case studies of earthquakes, landslides, cloudbursts and GLOFs from Himachal Pradesh and the Himalayan region.	15 Hours
Section 3	**Anthropogenic Impacts, Climate, and Disaster Mitigation** Human-induced environmental impacts: Terrain subsidence, coastal erosion, land degradation, and environmental impacts of mineral extraction and unplanned mining. Fundamentals of the global carbon cycle and introduction to climate change science. Effects of climate change on water resources, agriculture, ecosystems and human health. Disaster Management: basic concepts of disaster preparedness, Hazard zonation and community-level risk assessment, Safety measures and disaster-risk reduction strategies, post-disaster rehabilitation, and public response protocols. Role of local	15 Hours

Section	Contents and Detailed Topic Breakdown	Contact Hours
	communities, early warning systems and citizen participation in disaster risk reduction.	

iv. Evaluation Pattern: Internal Assessment: 25 Marks | End Term Written ESE: 50 Marks | Total Marks: 75. Examination structures mirror regular university MDC specifications exactly.

Course Code: BGEOL-SEC-201 | Course Title: Geomorphology

L: 3 | T: 0 | P: 0 | C: 3 Credits | CH: 45 Hours | Course Type: Skill Enhancement Course
Prerequisite: Successful completion of BGEOL-DSC-101.

i. Course Objectives: Present degradational vs aggradational dynamics, evaluate weathering/soil mechanics, trace drainage basin channels development, and detail landscape evolution models produced by diverse surface agents.

ii. Course Outcomes: Upon completion of this course, students are expected to:

- **CO1:** Distinguish between endogenic internal uplift forces and exogenic surficial denudation cycles.
- **CO2:** Explain slope instability categories, regolith production patterns, and rock weathering equations.
- **CO3:** Categorize erosional and depositional landforms associated with fluvial, aeolian, karst, marine, and glacial dynamics.

iii. Syllabus:

Section	Contents	Contact Hours
1	**External Dynamic Processes on the Earth** Fundamental Concepts and Principles of Geomorphology. Weathering, Erosion, and Mass Wasting: Factors controlling weathering, Types and Processes of Weathering (Physical, Chemical, and Biological), Soil Formation and Development of Regolith, Erosional Processes and Agents (Wind, Water), Mass Wasting Types, Causes, and Effects. Davisian Cycle of Erosion (brief concept).	15 Hours
2	**Fluvial Geomorphology and Processes** Fluvial Landforms: River Erosion, Transportation, and Deposition, Drainage Patterns and Their Significance. Landforms produced by rivers: youthful stage, mature stage and old stage. River rejuvenation, Knick points, Delta and its types.	15 Hours
3	**Aeolian, Groundwater, Glacial, and Marine Systems** Landforms Produced by Wind: Erosional and Depositional features in Arid Regions. Groundwater and related features: erosional and depositional features, Karst Topography. Ocean and Related Features (Beaches, Spits, Bars, Sea cliffs). Glaciers and Related Features: erosional features, Glacial transportation & Depositional features.	15 Hours

iv. Evaluation Pattern: Internal Performance Assessment: 25 Marks | End Semester Written Theory

Paper: 50 Marks | Total Course Marks: 75. Continuous internal marking tracks standard SEC evaluation patterns.

v. Pass requirement: Minimum 35% separately in Internal Assessment and End Semester Examination, and 40% in aggregate, as per University regulations.