ROYAL GLOBAL UNIVERSITY
GUWAHATI

ROYAL SCHOOL OF ENVIRONMENTAL AND EARTH SCIENCES (RSEES)

DEPARTMENT OF GEOLOGY

COURSE STRUCTURE & SYLLABUS

(BASED ON NATIONAL EDUCATION POLICY 2020)

FOR

B.Sc. IN GEOLOGY

(4 YEARS SINGLE MAJOR)

W.E.F. ACADEMIC YEAR

2023-24

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1. Preamble

In pursuit of an elevated vision for higher education, The Assam Royal Global University (RGU) proudly embraces the essence of the National Education Policy (NEP) 2020. We recognize the profound role of higher education in fostering equity, human welfare, societal advancement, and the realization of India's constitutional aspirations. Within this transformative framework, the Department of Geology envisions cultivating exceptional, well-rounded individuals equipped to thrive in the 21st century.

Our mission is to empower students with the ability to delve deeply into specialized areas of geology while nurturing character, ethical values, and a commitment to the Constitution. At the heart of our curriculum lies an unwavering dedication to intellectual curiosity, scientific temper, creativity, and a spirit of service. Embracing multidisciplinarity, we aim to instil twenty-first-century capabilities that span across sciences, social sciences, arts, humanities, languages, as well as professional, technical, and vocational subjects.

Endeavouring to unlock the potential of each student, our flexible curricula are designed with credit-based courses and transformative projects, embracing community engagement, service, and environmental education. We proudly offer invaluable opportunities for internships, bridging the gap between theory and practice. Our students actively collaborate with local industries, businesses, and artisans, gaining practical insights to enhance their employability and readiness for the challenges of the real world.

In reverence to India's profound Knowledge System, we integrate courses that honour the nation's rich heritage, encompassing ancient disciplines like Vedic Mathematics, Vedangas, Indian Astronomy, Fine Arts, and Metallurgy. This holistic education instils an enlightened social consciousness, equipping our graduates to contribute meaningfully to society, unravelling innovative solutions for the greater good.

Embodying the core values of RGU, the Department of Geology aspires to be a catalyst for knowledge creation, fostering a vibrant, cooperative community. Our commitment to excellence in higher education seeks to nurture a harmonious, progressive, and prosperous nation, driven by informed, skilled, and compassionate citizens.

2. Introduction

Welcome to the Department of Geology at The Assam Royal Global University (RGU), where our curriculum is thoughtfully crafted in alignment with the transformative vision of the National Education Policy (NEP) 2020. Embodying the principles that higher education plays a pivotal role in promoting human and societal well-being, we are dedicated to nurturing individuals who are not only well-rounded but also creative thinkers and innovators of the 21st century.

In response to the NEP's call for a multidisciplinary approach, our curriculum seamlessly integrates the humanities and arts with Science, Technology, Engineering, and Mathematics (STEM). Through this harmonious blend, our students gain a comprehensive understanding of geology, fostering creativity, critical thinking, problem-solving prowess, and higher-order cognitive abilities. With an emphasis on conceptual understanding rather than rote learning, we foster an environment that encourages logical decision-making and innovation, all while upholding the values of ethics, human rights, and constitutional principles.

As staunch proponents of flexibility and individuality, we empower our learners to chart their unique learning trajectories and programs, choosing paths that align with their talents and passions. Our curriculum is designed to impart in-depth knowledge across various fields, fostering expertise and holistic development. Additionally, we place significant value on life skills such as effective communication, teamwork, leadership, and resilience, empowering our students to thrive both academically and in their future endeavours.

Technology stands at the core of our teaching and learning methodology, enhancing accessibility, and removing language barriers to ensure inclusivity for all students, including Divyang individuals. Rooted in respect for

diversity, we take pride in contextualising our curriculum, pedagogy, and policies to celebrate the rich tapestry of India's cultures, knowledge systems, languages, and traditions.

Above all, we embrace the principles of equity and inclusion as the cornerstone of our educational decisions, ensuring a supportive and responsive institutional environment that enables all students to access high-quality education. With a deep-rooted appreciation for India's heritage, we infuse our curriculum with a sense of pride in its ancient and modern geology, nurturing a generation of geologists who can contribute meaningfully to the nation and the world.

As we embark on this journey of academic excellence, the Department of Geology at RGU is committed to fostering future geologists who not only unravel the mysteries of the Earth but also become compassionate, responsible, and socially conscious global citizens. Together, we pave the way for a vibrant and sustainable future, grounded in knowledge, innovation, and cultural understanding.

3. Approach to Curricular Planning

In the Department of Geology at The Royal Global University (RGU), our approach to curricular planning is deeply rooted in the visionary framework of the National Education Policy (NEP) 2020. As we shape our curriculum to meet the specific needs of geology students, we also draw inspiration from certain aspects of the Credit-Based Choice Based Credit System (CBCS) to enhance the learning experience. Our curriculum is thoughtfully designed with the following key elements:

1. Holistic Development: We prioritize the holistic development of our geology students. Beyond academic excellence, we aim to nurture their intellectual curiosity, critical thinking, and ethical values. Our curriculum fosters a deep appreciation for the natural world and instils a sense of environmental responsibility.

2. Learner-Centric Approach: Embracing the spirit of NEP 2020, our curricular planning adopts a learner-centric approach. We recognize the unique abilities and interests of each student, providing them with opportunities to tailor their academic journey and pursue specialized areas of geology.

3. Multidisciplinarity and Interdisciplinarity: Our geology curriculum integrates multidisciplinary knowledge, encompassing subjects like geography, physics, chemistry, and environmental studies. We encourage students to explore the interconnectedness of different disciplines, empowering them to become versatile professionals.

4. Flexibility and Choice: Drawing on certain inputs from CBCS, we offer geology students the flexibility to choose elective courses aligned with their interests and career goals. This freedom allows them to delve deeper into specific geology subfields and broaden their horizons.

5. Practical Experience and Research: Practical experiences and research play a pivotal role in our geology curriculum. Fieldwork, laboratory exercises, and research internships provide hands-on learning opportunities, honing students' field skills and analytical abilities.

6. Ethical and Environmental Values: We embed ethical values and environmental consciousness into our geology curriculum. Our students are encouraged to be responsible stewards of the Earth and to consider sustainability in their professional practice.

7. Continual Curriculum Review: Curricular planning in the Department of Geology is an ongoing process, subject to continuous review and improvement. We keep abreast of advancements in geology and consider industry feedback to ensure our curriculum remains cutting-edge and relevant.

8. Emphasis on Industry-Relevant Skills: Our geology curriculum places a strong emphasis on developing industry-relevant skills. Graduates are equipped with data analysis, GIS mapping, and geotechnical expertise, making them highly employable in various sectors.

9. International Perspectives: Embracing global awareness, we introduce international perspectives into our geology curriculum. Students explore geological phenomena worldwide, enriching their understanding of Earth's diverse geological processes.

In conclusion, the Department of Geology's approach to curricular planning at RGU seeks to create well-rounded geology professionals with a passion for exploration and environmental stewardship. Our dynamic and inclusive curriculum empowers students to become skilled geologists with a profound appreciation for the Earth's natural wonders and a commitment to contributing positively to society and the planet.

4. Award of Degree in B.Sc. Geology Programme

The structure and duration of undergraduate programmes of study offered by the University as per NEP 2020 include:

4.1. Undergraduate programmes of either 3 or 4-year duration with Single Major, with multiple entry and exit options, with appropriate certifications:

4.1.1. UG Certificate: Students who opt to exit after completion of the first year and have secured 40 credits will be awarded a UG certificate if, in addition, they complete one vocational course of 4 credits during the summer vacation of the first year. These students are allowed to re-enter the degree programme within three years and complete the degree programme within the stipulated maximum period of seven years.

4.1.2. UG Diploma: Students who opt to exit after completion of the second year and have secured 80 credits will be awarded the UG diploma if, in addition, they complete one vocational course of 4 credits during the summer vacation of the second year. These students are allowed to re-enter within a period of three years and complete the degree programme within the maximum period of seven years.

4.1.3. 3-year UG Degree: Students who will undergo a 3-year UG programme will be awarded UG Degree in the Major discipline after successful completion of three years, securing 120 credits and satisfying the minimum credit requirement.

4.1.4. 4-year UG Degree (Honours): A four-year UG Honours degree in the major discipline will be awarded to those who complete a four-year degree programme with 160 credits and have satisfied the credit requirements as given in the course structure.

4.1.5. 4-year UG Degree (Honours with Research): Students who secure 75% marks and above in the first six semesters and wish to undertake research at the undergraduate level can choose a research stream in the fourth year. They should do a research project or dissertation under the guidance of a Faculty Member of the University. The research project/dissertation will be in the major discipline. The students who secure 160 credits, including 12 credits from a research project/dissertation, will be awarded UG Degree (Honours with Research).

Award	Year	Credits to earn	Additional Credits	Re-entry allowed within (years)	Years to Complete
UG Certificate	1	40	4	3	7
UG Diploma	2	80	4	3	7

3-year UG Degree (Major)	3	120	x	x	x
4-year UG Degree (Honours)	4	160	x	x	x
4-year UG Degree (Honors with Research)	4	160	Students who secure cumulative 75% marks and above in the first six semesters.		

5. Graduate Attributes in Geology

Some of the characteristic attributes of a graduate in Geology are:

GA1: Disciplinary Knowledge: Upon completion of the B.Sc. Geology program, graduates will possess a comprehensive understanding of geological principles, theories, and methodologies. They will demonstrate proficiency in core geological concepts, including mineralogy, petrology, stratigraphy, and structural geology, enabling them to apply their knowledge to real-world geological challenges.

GA2: Complex Problem Solving: Graduates will be adept at tackling complex geological problems by employing a systematic and analytical approach. They will have honed their ability to analyse geological data, interpret geological phenomena, and propose viable solutions to address geological challenges and environmental issues.

GA3: Analytical & Critical Thinking: B.Sc. Geology graduates will be equipped with strong analytical and critical thinking skills, enabling them to evaluate geological data, identify patterns, and draw well-informed conclusions. They will apply critical thinking to assess the implications of geological findings and make informed decisions.

GA4: Creativity: Graduates will demonstrate creativity in approaching geological research and exploration. They will be capable of thinking innovatively to address geological challenges and propose novel solutions in geological exploration and resource management.

GA5: Communication Skills: B.Sc. Geology graduates will possess effective communication skills, both written and verbal, allowing them to articulate geological concepts, research findings, and exploration outcomes to diverse audiences. They will communicate complex geological information with clarity and precision.

GA6: Research-related Skills: Graduates will be equipped with research-related skills, including data collection, analysis, and interpretation. They will have experience in conducting geological research and utilizing various research methodologies to contribute to the advancement of geological knowledge.

GA7: Collaboration: Graduates will excel in collaborative settings, demonstrating an ability to work effectively as part of multidisciplinary teams. They will value diverse perspectives, fostering productive collaborations to address complex geological challenges.

GA8: Leadership Readiness/Qualities: B.Sc. Geology graduates will exhibit leadership readiness and qualities, taking initiative in geological projects and resource management. They will possess the skills to lead teams and guide geological initiatives with a sense of responsibility and vision.

GA9: Digital and Technological Skills: Graduates will be proficient in utilizing digital tools and technologies relevant to the field of geology. They will be adept at employing Geographic Information Systems (GIS), remote sensing, and other technological advancements in geological exploration and analysis.

GA10: Environmental Awareness and Action: Graduates will demonstrate a strong sense of environmental awareness and responsibility. They will consider the environmental impact of geological activities and strive to implement sustainable practices in geological exploration and resource management, contributing to environmental conservation and protection.

6. Program Learning Outcomes in B.Sc. Geology

Upon satisfactory completion of B.Sc. degree in Geology, the graduates will be able to achieve the following:

PLO1: Knowledge of Geology: Graduates will demonstrate a deep understanding of geological principles, theories, and concepts across various subfields of geology, including mineralogy, petrology, stratigraphy, and structural geology.

PLO2: Develop Complex Problem-Solving Skills in Geology: Graduates will be capable of analysing complex geological problems, synthesizing information from diverse sources, and proposing effective solutions to geological challenges and environmental issues.

PLO3: Develop Analytical & Critical Thinking Skills in Geology: Graduates will employ analytical and critical thinking skills to evaluate geological data, interpret geological phenomena, and make evidence-based judgments in geological research and exploration.

PLO4: Develop the ability to create: Graduates will exhibit creativity in geological research and exploration, demonstrating innovative thinking in addressing geological problems and proposing new approaches to geological investigations.

PLO5: Develop effective communication skills: Graduates will effectively communicate geological concepts and research findings to both specialized and non-specialized audiences through well-structured written reports, oral presentations, and visual representations.

PLO6: Develop Geological Research-related Skills: Graduates will demonstrate proficiency in conducting geological research, including data collection, analysis, and interpretation, and contribute to the advancement of geological knowledge through independent and collaborative research projects.

PLO7: Develop abilities to collaborate: Graduates will work effectively as part of multidisciplinary teams, valuing diverse perspectives and engaging in constructive collaborations to address geological challenges and explore research opportunities.

PLO8: Develop Leadership Qualities: Graduates will exhibit leadership readiness and qualities, displaying initiative in geological projects and resource management, and effectively leading teams towards achieving geological objectives.

PLO9: Develop Digital and Technological Skills in Geology: Graduates will utilize digital tools and technologies relevant to geology, including Geographic Information Systems (GIS), remote sensing, and geospatial analysis, to enhance geological exploration and analysis.

PLO10: Develop Environmental Awareness in geological activities: Graduates will demonstrate a strong sense of environmental awareness and responsibility in geological activities, striving to implement sustainable practices and contribute to environmental conservation and protection.

7. Program Specific Outcomes in B.Sc. Geology

Upon completion of this programme the student will be able to:

PSO 1	**Geological Knowledge and Understanding:** Upon completion of the B.Sc. Geology program, students will demonstrate a comprehensive knowledge and understanding of geological principles, concepts, and theories. They will be able to apply this knowledge to analyse geological phenomena and interpret geological data.
PSO 2	**Field Skills and Geological Surveys:** Students will develop proficiency in geological fieldwork, including mapping, sample collection, and data recording. They will be capable of conducting geological surveys and investigations in diverse terrains and geological settings.
PSO 3	**Environmental and Resource Assessment:** Students will understand the relationship between geology and the environment. They will acquire skills to assess the impact of geological activities on the environment and evaluate geological resources such as minerals, fossil fuels, and groundwater.

PSO 4	**Geotechnical Analysis and Hazard Assessment:** Students will be equipped with geotechnical analysis skills to evaluate the engineering properties of geological materials. They will also identify and assess geological hazards, such as earthquakes, landslides, and volcanic eruptions, contributing to disaster preparedness plans.

8. Teaching Learning Process

In the Department of Geology, our teaching-learning process for the B.Sc. Geology curriculum is designed to foster a dynamic and engaging educational experience, aligning with the transformative vision of the National Education Policy (NEP) 2020. The process encompasses the following key principles:

a) **Learner-Centric Approach:** We prioritize our students' needs and interests, adopting a learner-centric approach to education. Our faculty members create a supportive and inclusive learning environment, encouraging active participation and intellectual curiosity among students. Tutorial classes where a closer interaction between the students and the teacher is present as each student gets individual attention.

b) **Blended Teaching Methodologies:** We employ a blend of traditional and modern teaching methodologies, leveraging technology to enhance the learning process. Lectures, practical sessions, fieldwork, and virtual tools are integrated to provide a well-rounded understanding of geological concepts.

c) **Multidisciplinary Perspectives:** Recognizing the significance of multidisciplinary learning, we encourage students to explore diverse aspects of geology, including its intersections with environmental sciences, engineering, and geography. This approach broadens their perspectives and fosters interdisciplinary thinking.

d) **Experiential Learning:** Practical experiences and fieldwork form an integral part of our curriculum. Students actively engage in geological surveys, laboratory work, and research projects, honing their analytical and problem-solving skills. Very small projects like 1-day field-based projects are part of our curriculum so as to continuously boost their practical skills and knowledge.

e) **Research and Inquiry:** We emphasize research and inquiry-based learning, motivating students to undertake independent geological investigations. By delving into real-world geological challenges, students develop critical thinking abilities and contribute to the advancement of geological knowledge.

f) **Environmental Awareness:** Environmental consciousness is infused throughout the curriculum. Students are sensitized to the environmental impact of geological activities and explore sustainable practices to address geological challenges responsibly.

g) **Continuous Assessment:** Our teaching-learning process includes regular formative assessments to gauge student progress and offer constructive feedback. This approach enables personalized learning and promotes continuous improvement.

h) **Industry Collaboration:** We foster collaborations with industry experts and research organizations to provide students with exposure to the practical applications of geology. Guest lectures, workshops, and internships enhance their understanding of real-world geological scenarios.

i) **Communication and Presentation Skills:** We emphasize the development of effective communication and presentation skills. Students are encouraged to articulate their geological findings and research outcomes with clarity and precision. It includes Group discussions, Student presentations, Home assignments, Quizzes and class tests.

j) **Professional Ethics:** Professional ethics and integrity are instilled in our students' education. They are encouraged to uphold ethical standards in all aspects of geological practice, including research, exploration, and resource management.

k) **Mentor-Mentee Relationship:** The Mentor-Mentee relationship is an integral part of our teaching-learning process. Each B.Sc. Geology student is paired with a knowledgeable Mentor who provides individualized guidance, academic support, and career advice. The Mentor-Mentee relationship fosters a

supportive and nurturing environment, empowering students to reach their full potential and excel in their academic and personal development.

9. Assessment Methods

Methods	Weightage
Continuous Evaluation	30%
Semester End Examination	70%
Total	**100%**

The Continuous Evaluation component is again re-divided as per the following connotation:

- Class Participation (15%)
- Mid-Term Examination (10%)
- Attendance (5%)

Class Participation (15%): Every student's progress and performance are continuously adjudged throughout the semester in different ways such as Class Tests, Viva, Assignments, Project Work, and Seminars etc. 15% marks are allotted under the head 'Class Participation'.

Mid-Term Examination (10%): This is a written test conducted in the middle of the semester after completion of 30% to 40% of the course. 10% marks are allotted for Mid-Term Examination.

Attendance (5%): Ideally, a student is expected to attend 100% of the classes, but considering various hindrances like illness, accident, etc. a relaxation of maximum 25% is given, which means a student has to maintain an attendance of minimum 75% in each course; failing to do so will lead to debarment of the student from the examination in the said course. 1-5 marks are given to students having more than 75% attendance. Attendance is awarded to a student as per the following connotation:

Percentage of Attendance (%)	Marks
More than 95%	5
More than 90% and up to 95%	4
More than 85% and up to 90%	3
More than 80% and up to 85%	2
More than 75% and up to 80%	1
Up to 75%	0

Semester wise and component wise distribution of Courses
(Four Year UGP-Single Major)

Year	Semester	Major (Core)		Minor		Interdisciplinary	AEC-(English/MIL/Regional Language)	SEC/Internship/Apprenticeship/Dissertation	VAC	Total credits
		Course Level	No. of Courses	Course Level	No. of Course	No. of Courses	No. of Courses	No. of Courses	No. of Courses	
I	I	100	2	100	1	1	1	1	1	20
	II	100	2	100	1	1	1	1	1	20
	Exit -1: UG Certificate in the relevant discipline/Subject *Total credit requirement : 40 credit (Additional 4 credit of work based vocational course/ internship/ apprenticeship on exit)*									
2	III	200	2	(200 & above)	1	1	1	1	0	20
	IV	200	3	(200 & above)	2	0	1	0	0	20
	Exit -2:UG Diploma in the relevant discipline/subject *Total credit requirement: 80 credit (additional 4 credit of work based vocational course/internship/apprenticeship on exit) To undergo Summer Internship during Summer Break*									
3	V	300	3	(200 & above)	1	0	0	1 (internship)	0	20
	VI	300	4	(200 & above)	1	0	0		0	20
	For students who undertake 3 year UG Programme, UG Degree will be awarded in the relevant subject/discipline *Total credit requirement: 120*									
4	VII	400	4	(300 & above)	1	0	0	0	0	20
	VIII	400	2	(300 & above)	0	0	0	1 (Res. Proj/Dissertation)	0	20
									Total	**160**

Note:

After completion of Internship during Summer Term, students will have to submit a report with a completion certificate and comments from the internship supervisor/coordinator and make a presentation on his/her work relating the work to the overall learning objectives.

B. Sc. Geology

Programme Structure

1st SEMESTER				
Sl. No	**Course Code**	**Name of Courses**	**Course Level**	**Credits**
		Major Courses		
1	GEOL162M141	Physical Geology	100	3
2	GEOL162M142	Mineral Science	100	3
		Minor Course		
3	GEOL162N101	Physical Geology	100	3
		Interdisciplinary Courses		
4	IKS992K101	Indian Knowledge System 1	-	3
		Ability Enhancement Courses		
5	AEC982A101	Communicative English I	-	1
6	BHS982A104	Behavioural Science I	-	1
		Skill Enhancement Courses		
7	GEOL162S111	Geological Mapping and Surveying	-	3
		Value Added Courses		
8		VAC 1 (Basket Course)	-	3
			TOTAL	20

2nd SEMESTER				
Sl. No	**Course Code**	**Name of Courses**	**Course Level**	**Credits**
		Major Courses		
1	GEOL162M241	Geochemistry	100	3
2	GEOL162M242	Igneous Petrology	100	3
		Minor Course		
3	GEOL162N201	Geology and Natural Hazards	100	3
		Interdisciplinary Courses		
4	IKS992K201	Indian Knowledge System 2	-	3
		Ability Enhancement Courses		
5	AEC982A201	Communicative English II	-	1
6	BHS982A204	Behavioural Science II	-	1
		Skill Enhancement Courses		
7	GEOL162S211	Geomorphology and Landform Analysis	-	3
		Value Added Courses		
8		VAC 2 (Basket Course)	-	3
			TOTAL	20

3rd SEMESTER				
Sl. No	**Course Code**	**Name of Courses**	**Course Level**	**Credits**
		Major Courses		
1	GEOL162M341	Metamorphic Petrology	200	4
2	GEOL162M342	Sedimentology	200	4
		Minor Course		
3	GEOL162N301	Mineralogy	200	4
		Interdisciplinary Courses		
4		(Basket Course)	-	3
		Ability Enhancement Courses		
5	AEC982A301	Communicative English III	-	1
6	BHS982A304	Behavioural Science III	-	1

		Skill Enhancement Courses		
7	GEOL162S311	Remote Sensing and GIS	-	3
			TOTAL	20
4th SEMESTER				
Sl. No	**Course Code**	**Name of Courses**	**Course Level**	**Credits**
		Major Courses		
1	GEOL162M441	Principles of Stratigraphy	200	4
2	GEOL162M442	Palaeontology	200	4
3	GEOL162M403	Earth Science in Ancient India (IKS)	200	4
		Minor Course		
3	GEOL162N402	Petrology	200	3
4	GEOL162N403	Structural Geology	200	3
		Ability Enhancement Courses		
5	AEC982A401	Communicative English IV	-	1
6	BHS982A404	Behavioural Science IV	-	1
			TOTAL	20
5th SEMESTER				
Sl. No	**Course Code**	**Name of Courses**	**Course Level**	**Credits**
		Major Courses		
1	GEOL162M541	Structural Geology	300	4
2	GEOL162M502	Indian Stratigraphy	300	4
3	GEOL162M543	Hydrogeology	300	4
4	GEOL162M524	Summer Internship	-	4
		Minor Course		
5	GEOL162N501	Fuel Geology	200	4
			TOTAL	20
6th SEMESTER				
Sl. No	**Course Code**	**Name of Courses**	**Course Level**	**Credits**
		Major Courses		
1	GEOL162M641		300	4
2	GEOL162M642	Economic Geology	300	4
3	GEOL162M643	Engineering and Environmental Geology	300	4
4	GEOL162M644	Coal and Petroleum Geology	300	4
		Minor Course		
5	GEOL162N601	Environmental Geology	200	4
			TOTAL	20
7th SEMESTER				
Sl. No	**Course Code**	**Name of Courses**	**Course Level**	**Credits**
		Major Courses		
1	GEOL162M701	Exploration and Mining Geology	400	4
2	GEOL162M702	Climatology and Oceanography	400	4
3	GEOL162M743	Urban Geology	400	4
4	GEOL162M744	River Science	400	4
		Minor Course		
5	GEOL162N701	Stratigraphy	300	4
			TOTAL	20

8th SEMESTER				
Sl. No	**Course Code**	**Name of Courses**	**Course Level**	**Credits**
		Major Courses		
1	GEOL162M841	Planetary Geology	400	4
2	GEOL162M802	Research Methodology	400	4
3	GEOL162M823	Dissertation	-	12
		Advanced Course in lieu of Dissertation		
4	GEOL162M844	Advanced Petrology	400	4
5	GEOL162M845	Advanced Structural Geology & Tectonics	400	4
6	GEOL162M846	Advanced Palaeontology	400	4
			TOTAL	20

Preferred list of Value-Added Courses for the students of B.Sc. Geology				
Sl. No.	**Course Name**	**Semester**	**Credits = 3**	
			Theory	**Practical**
1	Climate Change	1	2	1
2	Renewable Energy and Sustainable Technologies	1	2	1
3	Climate Writing	1	2	1
4	Disaster Management	2	2	1
5	Sustainable Development and Green Living	2	2	1
6	Community-Based Approaches to Environmental Conservation	2	2	1

Detailed Syllabus Of Semester 1

Type of Course: Major	Physical Geology Course Level: 100 Credit: 3 L-T-P-C: 2-0-2-3 Scheme of Evaluation: Theory + Practical	Course Code: GEOL162M141

Course Objectives: Physical Geology is an introductory course that covers the fundamental principles of geology. It provides an understanding of the Earth's internal and external processes that shape the Earth's surface and subsurface features. This course covers a range of topics, including mineralogy, petrology, plate tectonics, structural geology, and geological time.

Course Outcomes	Description	Bloom's Taxonomy
CO 1	Remember the fundamental concepts of geology, including the rock cycle, plate tectonics, and geological time.	**BT 1**
CO 2	Explain the processes that form the Earth's surface features and analyze the geological structures and their influence on the formation of natural resources.	**BT 2**
CO 3	Apply the principles of mineralogy and petrology to identify and classify different types of rocks and minerals, interpret geological maps and cross-sections, and solve geological problems.	**BT 3**
CO 4	Analyse geomorphological processes and data to understand the various geomorphic activities and their impact on landscape evolution.	**BT 4**

Modules	Topics and Course Content	Hours
Unit 1	Earth Science & its branches. Origin and evolution of the Universe and Solar System, The standard model of planetary formation. General features of the components of the solar system. Distribution of elements in solar system and in Earth.	10
Unit 2	Mechanical layering of the Earth: lithosphere, asthenosphere, mantle and core. Formation of core, mantle, crust, hydrosphere, and atmosphere. Introduction to Rocks – its types and associated features. Introduction to the concept of Geological Time Scale.	10
Unit 3	Concept of continental drift, seafloor spreading and plate tectonics. Plate boundaries and their geological effects: origin of oceans, continents, mountains and rift valleys. Earthquake and earthquake belts. Volcanoes and its types, distribution and eruptions. Geothermal gradient and internal heat of the Earth. Earth's magnetic field; Convection in Earth's core and production of its magnetic field.	12
Unit 4	Geomorphological processes and their significance. concept of base level and datum. Concept of exogenic and endogenic processes. Weathering, erosion, mass-wasting and their types. Landforms produced by – glacial processes, fluvial processes, aeolian processes, coastal processes, igneous activities.	12
List of Practicals	Interpretation of geomorphic processes of the area with the help of geomorphic models. Preparation of topographic profile from given contour map. Preparation of longitudinal profile of a river. Calculation of Stream length gradient index. Understanding active tectonism with the help of different morphometric parameters.	30
Experiential Learning: Home Assignments – 8 hrs, Presentation – 4 hrs, Video Screening – 4 hrs		16
Total Notional Credit Hours		**90**

Text Books:

1) Introduction to Physical Geology – Thompson & Turk
2) Essentials of Geology - Stephen Marshak, 4th edition, W. W. Norton & Company

Reference Books:

1) Physical Geology – R. F. Flint and J Skinner, John Wiley and Sons, Inc.
2) Global Tectonics - Philip Kearey, Keith A. Klepeis, Frederick J. Vine, (3rd edition, 2009), Wiley-Blackwell.

Type of Course: Major	Mineral Science Course Level: 100 Credit: 3 L-T-P-C: 2-0-2-3 Scheme of Evaluation: Theory + Practical	Course Code: GEOL162M142

Course Objectives: Mineral Science is an undergraduate-level course that focuses on the study of minerals and their properties, including crystallography, optical properties, chemical composition, and physical characteristics. The course provides an overview of the formation and classification of minerals, as well as the processes involved in their identification and analysis.

Course Outcomes	Description	Bloom's Taxonomy
CO 1	Remember and identify the properties of minerals, their classification, and crystallographic systems.	**BT 1**
CO 2	Explain the physical and chemical properties of minerals and their economic importance.	**BT 2**
CO 3	Apply mineralogical knowledge to identify minerals using optical microscopy and physical characteristics of the specimens.	**BT 3**
CO 4	Analyse various crystallographic and mineralogical data to identify and classify them into various classes.	**BT 4**

Modules	Topics and Course Content	Hours
Unit 1	Unit cell and Lattice structures, Bravais Lattices; Types of crystal structures (e.g., cubic, hexagonal); Symmetry elements and point groups; Crystallographic axes and planes; Overview of crystal systems (e.g., isometric, tetragonal, etc.); Crystallographic axes and symmetry elements for each system.	11
Unit 2	Interfacial angle, crystal parameters and indices. Stereograms and Hermann- Mauguin System. Relationship between crystallography and mineral properties. Concept of crystal, crystalline and amorphous substances. Minerals - definition, physical and chemical properties; Chemical classification of minerals.	11
Unit 3	Silicate and non-silicate structures of minerals. Study of physical properties of minerals of the following group of minerals: Olivine, Pyroxene, Amphibole, Mica, Silica and Feldspar.	11
Unit 4	Polarization of light, Polarisers. Functions of petrological microscope. Optical behaviour of minerals: Absorption, Transmission and Double-refraction of light. Theory of light propagation in minerals: Isotropy and Anisotropy; Optic axis. Optical properties of minerals in thin section. Introduction to X-Ray diffractometry in minerals.	11
List of Practicals	Exercises on stereographic projection of crystal faces. Study of the following silicate minerals in hand specimen and under optical microscope: Olivine, Garnet, Sillimanite, Kyanite, Staurolite, Tourmaline, Enstatite, Diopside, Augite, Actinolite, Hypersthene, Hornblende, Serpentine, Muscovite, Biotite, Quartz and its varieties, Orthoclase, Plagioclase, Microcline, Nepheline, Sodalite, Calcite, Beryl, Talc, Zeolite. Determination of Pleochroic Scheme of minerals. Identification of Plagioclase Feldspars by Michel-Levy method.	30
Experiential Learning: Home Assignments – 8 hrs, Presentation – 4 hrs, Video Screening – 4 hrs		16
Total Notional Credit Hours		**90**

Text Books Suggested:

1) Mineralogy - Dexter Perkins, 3rd edition (2015), Pearson Publication.

Reference books:

1) Introduction to Optical Mineralogy – William D. Nesse, 3rd edition (2004), Oxford University Press.
2) The Manual of Mineral Science (after James D. Dana) - Dutrow, B., Dwight, J., & Klein, C.; (2007) J. Wiley & Sons.
3) Introduction to Rock Forming Minerals – W. A. Deer, R. A. Howie, and J. Zussman, 3rd edition (2013), Prentice Hall.

Type of Course: Minor	Physical Geology Course Level: 100 Credit: 3 L-T-P-C: 3-0-0-3 Scheme of Evaluation: Theory	Course Code: GEOL162N101

Course Objectives: This course provides an overview of the fundamental principles of physical geology, focusing on the study of Earth's processes, materials, and the dynamic forces that shape the planet.

Course Outcomes	Description	Bloom's Taxonomy
CO 1	Demonstrate a comprehensive understanding of Earth's structure, composition, and geological processes.	**BT 1**
CO 2	Comprehend the principles of plate tectonics and the processes that drive geological changes.	**BT 2**
CO 3	Apply geological concepts to explain natural phenomena, such as earthquakes, volcanoes, and mountain formation.	**BT 3**
CO 4	Analyze geological data to interpret Earth's history and the formation of various geological formations.	**BT 4**

Modules	Topics and Course Content	Hours
Unit 1	Definition and scope of physical geology Earth's structure, composition, and geologic time Study of minerals and their properties Classification and identification of rocks	17
Unit 2	Understanding plate movements and boundaries The role of plate tectonics in earthquakes, volcanoes, and mountain building Understanding seismicity and volcanic eruptions Impact of earthquakes and volcanoes on the Earth's surface	16
Unit 3	Study of weathering, erosion, mass-wasting and sedimentation Fluvial, glacial, marine and coastal processes and features. Epirogenic processes and movements.	17
Unit 4	Geological processes and their influence on the environment Human interaction with geological hazards such as landslides, earthquakes, volcanic eruptions, floods, mining activities and other civil engineering projects. Relationship between geology and climate change.	16
Experiential Learning: Home Assignments – 10 hrs, Presentation – 10 hrs, Video Screening – 4 hrs		24
Total Notional Credit Hours		**90**

Text Books:

1) Introduction to Physical Geology – Thompson & Turk
2) Essentials of Geology - Stephen Marshak, 4th edition, W. W. Norton & Company

Reference Books:

1) Physical Geology – R. F. Flint and J Skinner, John Wiley and Sons, Inc.
2) Global Tectonics - Philip Kearey, Keith A. Klepeis, Frederick J. Vine, (3rd edition, 2009), Wiley-Blackwell.

Type of Course: SEC	Geological Mapping and Surveying Credit: 3 L-T-P-C: 0-0-6-3 Scheme of Evaluation: Practical	Course Code: GEOL162S111

Course Objectives: The course focuses on developing hands-on skills in collecting geological data, understanding geological formations, and creating geological maps.

Course Outcomes	Description	Bloom's Taxonomy
CO 1	Comprehend the various methods and instruments used in geological fieldwork.	**BT 1**
CO 2	Understand the significance of geological mapping and surveying in geological exploration and research.	**BT 2**
CO 3	Apply geological surveying techniques to measure and record geological features in the field.	**BT 3**
CO 4	Analyze and interpret geological field data to identify rock types, stratigraphic sequences, and structural elements.	**BT 4**
CO 5	Evaluate the reliability and accuracy of geological data collected during fieldwork.	**BT 5**
CO 6	Synthesize field data to create detailed geological maps and cross-sections.	**BT 6**

Modules	Topics and Course Content	Hours
Unit 1	Introduction to Geological Mapping and Surveying: Definition and importance of geological mapping. Overview of geological surveying techniques and instruments. Fieldwork Preparation: Planning and organizing a geological field survey. Safety considerations and fieldwork logistics.	17
Unit 2	Topographic Mapping: Understanding topographic maps and contour lines. Topographic map reading and interpretation. Concept of Toposheet indexing. Use of handheld GPS for geological surveying. Basics of Total Station Survey. Distance, height and pace approximation in geological traversing.	16
Unit 3	Geological Field Techniques: Identification and classification of rocks and minerals in the field. Measuring geological structures, including folds, faults, and joints. Structural Mapping: Mapping and interpreting geological structures such as folds and faults. Analysis of structural deformation in the field.	17
Unit 4	Geological Mapping Project: Conducting a comprehensive geological survey and mapping project. Creating a detailed geological map and report based on field data.	16
Experiential Learning: Field Trip		24
Total Notional Credit Hours		**90**

Text Books suggested:

1) Guide to Field Geology – S. M. Mathur, PHI Publications
2) Field Geology – F. H. Lahee, CBS Publishers and Distributors Pvt Ltd; Sixth Edition (2002)

Reference Books:

1) Manual of Field Geology – Robert R. Compton; John Wiley & Sons.
2) Basic Methods of Structural Geology – Stephen Marshak & Gautam Mitra; Pearson Publication.

Detailed Syllabus Of Semester 2

Type of Course: Major	Geochemistry	Course Code:
	Course Level: 100 Credit: 3 L-T-P-C: 2-0-2-3 Scheme of Evaluation: Theory + Practical	GEOL162M241

Course Objectives: Geochemistry is the study of the chemical composition, structure, and processes of the Earth and other planets. This course covers the fundamentals of geochemistry, including the principles of thermodynamics, kinetics, isotope geochemistry, and major and trace element geochemistry.

Course Outcomes	Description	Bloom's Taxonomy
CO 1	Remember the basic concepts of geochemistry, including thermodynamics, kinetics, and isotope geochemistry.	**BT 1**
CO 2	Understand the principles of major and trace element geochemistry and their applications in geological systems.	**BT 2**
CO 3	Apply geochemical methods to investigate geological processes and solve geological problems.	**BT 3**
CO 4	Analyse geochemical data using appropriate statistical and graphical techniques.	**BT 4**

Modules	Topics and Course Content	Hours
Unit 1	Definition and scope of geochemistry in Earth sciences. Major geological reservoirs and elemental abundances in the Earth's crust. Introduction to properties of elements: The periodic table, atomic environment of elements. Geochemical classification of elements.	11
Unit 2	Types of chemical bonding in minerals and rocks. Crystal structures and their influence on mineral properties. Geochemical cycles of major elements (C, O, N, S) in the Earth's crust. Concepts of mass balance. Conservation of mass, isotopic and elemental fractionation. Fractionation and partitioning of elements during geological processes.	11
Unit 3	Chemical differentiation and Composition of the Earth (Continental crust, Oceanic crust, depleted mantle, enriched mantle and core). Geology of Meteorites. Cosmic abundance of elements. Geochemical variability of magma and its products.	11
Unit 4	Basic concepts of Aqueous geochemistry, Eh-pH relations. Mineral reactions- diagenesis and hydrothermal reactions. Chemical changes during metamorphism and metasomatism. Stable and radiogenic isotope systems and their applications. Isotopic dating methods and their use in geochronology.	11
List of Practicals	Types of geochemical data analysis and interpretation of common geochemical plots. Geochemical variation diagrams and its interpretations (bivariate and trivariate plots): Harker variation diagram, AFM diagram. Norm calculation of silica saturated igneous rocks.	30
Experiential Learning: Home Assignments – 8 hrs, Presentation – 4 hrs, Video Screening – 4 hrs		16
Total Notional Credit Hours		**90**

Text books:

1) Geochemistry – W. M. White, (2013), Wiley-Blackwell Publishing.
2) Introduction to Geochemistry: Principles and Applications - Kula C. Misra, (2012), Wiley-Blackwell Publishing.

Reference books:

1) Principles of Geochemistry - Mason, B., (3rd Edition, 1986), Wiley New York.
2) Essentials of geochemistry - Walther, J. V. (2009), Jones & Bartlett Publishers.

Type of Course: Major	Igneous Petrology Course Level: 100 Credit: 3 L-T-P-C: 2-0-2-3 Scheme of Evaluation: Theory + Practical	Course Code: GEOL162M242

Course Objectives: Igneous Petrology is a course designed to provide an understanding of the origin, classification, textures, and mineralogy of igneous rocks. The course will cover the processes that lead to the formation of magmas, their emplacement and crystallization, and the resultant diversity of igneous rocks. The course will also explore the relationship between igneous processes and tectonic settings.

Course Outcomes	Description	Bloom's Taxonomy
CO 1	Classify igneous rocks based on their mineralogy and textures.	**BT 1**
CO 2	Describe the processes involved in the formation of magmas and their subsequent crystallization into igneous rocks. Explain the relationship between igneous processes and tectonic settings.	**BT 2**
CO 3	Analyse and interpret igneous rock suites using microscopic and macroscopic techniques.	**BT 3**
CO 4	Evaluate the applications of igneous petrology in geologic exploration and mineral resource identification.	**BT 4**

Modules	Topics and Course Content	Hours
Unit 1	Introduction: Heat flow, geothermal gradient, Physical and chemical properties of magmas. Classification and nomenclature of igneous rocks. Textures and structures of igneous rocks. Mode of occurrence of Igneous rocks.	11
Unit 2	Types of magma sources. Magma chambers. Melting processes in the Earth's mantle and crust. Magma ascent and eruption and their products. Nucleation and Crystallisation rates. Crystallisation of Magma, Reaction Principle, Mechanisms of Magmatic differentiation, Role of volatiles in magmatic differentiation.	12
Unit 3	Classification schemes for plutonic and volcanic rocks. Petrogenesis of Felsic and Mafic igneous rocks: Granitoids, Basalt, Gabbro, Alkaline rocks, peridotites and kimberlites. Continental rifting and flood basalts.	10
Unit 4	Plate tectonics and igneous rock formation. Igneous rocks as indicators of tectonic processes. Oceanic crust formation and composition. Volcanic eruptions and associated rocks. Volcanic hazards monitoring. Major igneous provinces of NE India. Barren Island Volcanics.	11
List of Practicals	Study of important igneous rocks in hand specimens and thin sections (textural and mineralogical): granite, granodiorite, diorite, gabbro, anorthosites, ultramafic rocks, basalts, andesites, trachyte, rhyolite, dacite.	30
Experiential Learning: Home Assignments – 8 hrs, Presentation – 4 hrs, Video Screening – 4 hrs		16
Total Notional Credit Hours		**90**

Text Books Suggested:

1) Principles of igneous and metamorphic petrology – A. Philpotts & J. Ague. (2009). Cambridge University Press.
2) Principles of igneous and metamorphic petrology – J. D. Winter (2014). Pearson

Reference Books:

1) Petrology: the study of igneous, sedimentary, and metamorphic rocks. L. A. Raymond, (2002). McGraw-Hill Science Engineering
2) Principles of Petrology – G. W. Tyrrell. (1926). Springer

Type of Course: Minor	Geology and Natural Hazards			Course Code: GEOL162N201
	Course Level: 100	Credit: 3	L-T-P-C: 3-0-0-3	
		Scheme of Evaluation: Theory		

Course Objectives: The course explores the geological factors and interactions that lead to earthquakes, volcanic eruptions, landslides, floods, and other geological hazards. It also emphasizes the understanding of hazard assessment, mitigation, and their impact on society and the environment.

Course Outcomes	Description	Bloom's Taxonomy
CO 1	Remember and identify the geological and environmental impacts of different hazards.	**BT 1**
CO 2	Understand the geological processes responsible for natural hazards.	**BT 2**
CO 3	Apply geological and geophysical principles to hazard assessment and mapping.	**BT 3**
CO 4	Analyse case studies of past geological hazards and their societal implications.	**BT 4**
CO 5	Evaluate the role of geologists in assessing and mitigating natural hazards.	**BT 5**

Modules	Topics and Course Content	Hours
Unit 1	Definition and classification of natural hazards Overview of geological processes and their relation to hazards Plate tectonics and seismicity, Seismic waves and earthquake mechanisms Volcanic processes and types of eruptions Volcanic landforms and volcanic risk assessment	17
Unit 2	Causes and triggers of landslides Landslide types and susceptibility mapping Floods and its contributing factors, Concept of Flood cyclicity Floodplain and flood risk assessment	16
Unit 3	Tsunami generation and propagation Coastal erosion and impact on communities Cloud-burst and their environmental impact. Sink-holes – its causes and environmental impact. Radon emanation and its potential health hazards.	17
Unit 4	Development of hazard mitigation plans and policies Analysis of historic geological disasters and their impact Social and environmental justice in hazard response Ethical responsibilities of geologists in hazard assessment and communication	16
Experiential Learning: Home Assignments – 10 hrs, Presentation – 10 hrs, Video Screening – 4 hrs		24
Total Notional Credit Hours		**90**

Text Books Suggested:

1) Natural Hazards and Disasters: Donald Hyndman, David Hyndman, 5th Edition, 2020, Cengage Learning.
2) Earthquakes and Geological Hazards - The Next Generation: Timothy L. Hall, Michael L. Anderson, 2nd Edition, 2021, Wiley-Blackwell.

Reference Books:

1) Volcanoes – Global Perspectives: John P. Lockwood, Richard W. Hazlett, 3rd Edition, 2015, Wiley-Blackwell.
2) Landslides – Types, Mechanisms, and Modelling: Jean Hutchinson, 1st Edition, 2011, Cambridge University Press.
3) Atmosphere, Clouds, and Climate: David Randall, 1st Edition, 2012, Princeton University Press.

Type of Course: SEC	Geomorphology and Landform Analysis Credit: 3 L-T-P-C: 0-0-6-3 Scheme of Evaluation: Practical	Course Code: GEOL162S211

Course Objectives: This practical and field-based course focuses on developing students' practical skills in understanding and interpreting various landforms and their significance in geological studies.

Course Outcomes	Description	Bloom's Taxonomy
CO 1	Identify different landforms and understand their formation mechanisms.	**BT 1**
CO 2	Comprehend the relationship between tectonics, climate, and surface processes in shaping landforms.	**BT 2**
CO 3	Apply geomorphological principles to interpret landscape evolution during field studies.	**BT 3**
CO 4	Analyse the formation and significance of specific landforms through field investigations.	**BT 4**
CO 5	Evaluate the influence of human activities on landform evolution through practical case studies.	**BT 5**
CO 6	Integrate geomorphological knowledge with geological mapping during field exercises.	**BT 6**

Modules	Topics and Course Content	Hours
Unit 1	Introduction to field instruments and geospatial tools Field study of river systems and their dynamics Analysis of flow regimes, sediment transport, and channel morphology Field identification and interpretation of erosional features Exploration of valleys, gullies, and river terraces	20
Unit 2	Field investigations of depositional features Study of alluvial fans, floodplains, and meander belts Practical exercises on sediment characterization and analysis Understanding sedimentary structures and their significance	20
Unit 3	Field-based assessment of fluvial response to climate variations Identification of paleochannels and fluvial terraces Field-based study of anthropogenic influences on river dynamics Evaluation of river management and restoration practices	25
Unit 4	Practical application of GIS, remote sensing, and digital terrain models for fluvial mapping Study of fluvial landforms and sedimentary processes using geospatial tools	25
Total Notional Credit Hours		**90**

Text Books suggested:

1) Fluvial Geomorphology: Luna B. Leopold, M. Gordon Wolman, and John P. Miller, 1st Edition, 2014, W. H. Freeman and Company.
2) Geomorphology and Global Environmental Change: Olav Slaymaker and Thomas Spencer, 1st Edition, 2012, Cambridge University Press.

Reference Books:

1) Principles of Geomorphology: William D. Thornbury, 1st Edition, 2019, Wiley-Blackwell.
2) Applied Fluvial Geomorphology for River Engineering and Management: Philip J. Ashworth, Gary J. Brierley, and G. Mathias Kondolf, 2nd Edition, 2019, Wiley-Blackwell.

Detailed Syllabus Of Semester 3

Type of Course: Major	Metamorphic Petrology Course Level: 200 Credit: 4 L-T-P-C: 3-0-2-4 Scheme of Evaluation: Theory + Practical	Course Code: GEOL162M341

Course Objectives: This course provides an in-depth understanding of the origin, classification, and petrological properties of metamorphic rocks. Students will learn about the various metamorphic processes, including the role of fluids and deformation, and how these processes influence mineral assemblages and textures. The course also covers the use of metamorphic petrology in understanding the tectonic and thermal history of a region.

Course Outcomes	Description	Bloom's Taxonomy
CO 1	Describe the classification and nomenclature of metamorphic rocks.	**BT 1**
CO 2	Identify and interpret the mineral assemblages and textures of metamorphic rocks, and explain their significance.	**BT 2**
CO 3	Apply knowledge of metamorphic processes and petrographic techniques to identify and interpret metamorphic rocks and their evolution.	**BT 3**
CO 4	Analyse the factors that control the metamorphic process, including pressure, temperature, fluids, and deformation.	**BT 4**

Modules	Topics and Course Content	Hours
Unit 1	**Metamorphism:** Definition of metamorphism. Factors controlling metamorphism. Types of metamorphism - contact metamorphism, regional metamorphism, fault zone metamorphism, impact metamorphism.	9
Unit 2	**Metamorphic facies and grades** Mineralogical phase rule of closed and open system. Index minerals, Chemographic projections. Metamorphic zones and isograde. Concept of metamorphic facies and grade.	9
Unit 3	**Metamorphism and Tectonism & Petrogenesis** Relationship between metamorphism and deformation. Structure and textures of metamorphic rocks. Metamorphic mineral reactions (prograde and retrograde).	9
Unit 4	**Petrogenesis** Migmatites and their origin. Metasomatism and role of fluids in metamorphism. Petrogenesis of metamorphic rock associations- schists, gneisses, khondalites, charnockites, blue schists and eclogites.	9
List of Practicals	Hand Specimen and Microscopic study of the following metamorphic rocks: Low grade metamorphic rocks: serpentinites, albite-epidote-chlorite quartz schist, slate, talc-tremolite, quartz-mica schist., quartzo-feldspathic gneiss Medium to high grade metamorphic rocks: amphibolite, hornfels, garnetiferous schists, sillimanite-kyanite-bearing rocks, Granulites, eclogite, diopside-forsterite marble. Graphical plots and their interpretation.	30
Experiential Learning: Home Assignments – 8 hrs, Presentation – 8 hrs, Video Screening – 8 hrs		24
Total Notional Credit Hours		**120**

Text books:

1) Principles of igneous and metamorphic petrology – A. Philpotts & J. Ague. (2009). Cambridge University Press.
2) Principles of igneous and metamorphic petrology – J. D. Winter (2014). Pearson

Reference books:

1) Petrology: the study of igneous, sedimentary, and metamorphic rocks. L. A. Raymond, (2002). McGraw-Hill Science Engineering
2) Igneous and Metamorphic Petrology - Myron G. Best (2001).

Type of Course: Major	Sedimentology	Course Code:
	Course Level: 200 Credit: 4 L-T-P-C: 3-0-2-4 Scheme of Evaluation: Theory + Practical	GEOL162M342

Course Objectives: This course will focus on the processes of sedimentation, the diagenesis of sediments, and the properties and classification of sedimentary rocks. Topics covered will include sedimentary environments, depositional processes, sedimentary structures, mineralogy, texture, and sedimentary rock classification. The course will also cover the interpretation of sedimentary rocks in terms of paleoenvironmental and paleoclimatic conditions.

Course Outcomes	Description	Bloom's Taxonomy
CO 1	Students will be able to recall and recognize the key concepts, principles, and facts related to sedimentary petrology.	**BT 1**
CO 2	Students will be able to explain the processes of sedimentation, diagenesis, and lithification that result in the formation of sedimentary rocks.	**BT 2**
CO 3	Students will be able to apply the principles and concepts of sedimentary petrology to analyze and interpret the origin, composition, and classification of sedimentary rocks.	**BT 3**
CO 4	Students will be able to analyse sedimentary rocks in terms of their texture, mineralogy, sedimentary structures, and depositional environments.	**BT 4**

Modules	Topics and Course Content	Hours
Unit 1	Weathering and sedimentary flux: Physical and chemical weathering. Sedimentary texture: size, shape, roundness, sphericity, fabric, packing. Concepts of diagenesis, Stages of diagenesis, Compaction and cementation.	9
Unit 2	Textural classification of sediments and sedimentary rocks. Sediment dynamics: Nature of fluid flow – Laminar vs. turbulent flow, concept of flow regime and sediment transport. Sedimentary structures – bedforms and internal stratification.	9
Unit 3	Concept of sedimentary facies. Depositional features associated with fluvial, marine, desert, glacial and lacustrine environments (textural properties and structures).	9
Unit 4	Concept of Paleocurrent analysis. Mineralogical classification of sediments and sedimentary rocks (clastics and non-clastics). Geochemical fence.	9
List of Practicals	Grain size analysis of sediments (sieve and pipette method) Determination of roundness and sphericity of sediment grains. Study of sedimentary structures in hand specimens/peel specimens. Paleocurrent analysis. Petrography of clastic and non-clastic rocks through hand specimens. Petrography of clastic and non-clastic rocks through thin sections. Heavy mineral study.	30
Experiential Learning: Home Assignments – 8 hrs, Presentation – 8 hrs, Video Screening – 8 hrs		24
Total Notional Credit Hours		**120**

Text Books Suggested:

1) Introduction to Sedimentology – S. M. Sengupta, (2018), CBS.
2) Depositional Sedimentary Environments - Reineck and Singh, (1980), Springer – Verlag.

Reference Books:

1) Sedimentology and Stratigraphy - Nichols, G. (2009), Second Edition. Wiley Blackwell.
2) Sedimentary Rocks – F. J. Pettijohn.
3) Sedimentary Petrology – Tucker, M. E. (2006), Blackwell Publishing.
4) Petrology of Sedimentary Rocks – Sam Boggs, (2nd edition, 2009), Cambridge University Press, New York.

Type of Course: Minor	Mineralogy Course Level: 200 Credit: 4 L-T-P-C: 3-0-2-4 Scheme of Evaluation: Theory + Practical	Course Code: GEOL162N341

Course Objectives: Mineralogy is an undergraduate-level course that focuses on the study of minerals and their properties, including crystallography, optical properties, chemical composition, and physical characteristics. The course provides an overview of the formation and classification of minerals, as well as the processes involved in their identification and analysis.

Course Outcomes	Description	Bloom's Taxonomy
CO 1	Remember and identify the properties of minerals, their classification, and crystallographic systems.	**BT 1**
CO 2	Explain the physical and chemical properties of minerals and their economic importance.	**BT 2**
CO 3	Apply mineralogical knowledge to identify minerals using optical microscopy and physical characteristics of the specimens.	**BT 3**
CO 4	Analyse various crystallographic and mineralogical data to identify and classify them into various classes.	**BT 4**

Modules	Topics and Course Content	Hours
Unit 1	Unit cell and Lattice structures, Bravais Lattices; Types of crystal structures (e.g., cubic, hexagonal); Symmetry elements and point groups; Crystallographic axes and planes; Overview of crystal systems (e.g., isometric, tetragonal, etc.); Crystallographic axes and symmetry elements for each system.	9
Unit 2	Interfacial angle, crystal parameters and indices. Stereograms and Hermann- Mauguin System. Relationship between crystallography and mineral properties. Concept of crystal, crystalline and amorphous substances. Minerals - definition, physical and chemical properties; Chemical classification of minerals.	9
Unit 3	Silicate and non-silicate structures of minerals. Study of physical properties of minerals of the following group of minerals: Olivine, Pyroxene, Amphibole, Mica, Silica and Feldspar.	9
Unit 4	Polarization of light, Polarisers. Functions of petrological microscope. Optical behaviour of minerals: Absorption, Transmission and Double-refraction of light. Theory of light propagation in minerals: Isotropy and Anisotropy; Optic axis. Optical properties of minerals in thin section. Introduction to X-Ray diffractometry in minerals.	9
List of Practical	Exercises on stereographic projection of crystal faces. Study of the following silicate minerals in hand specimen and under optical microscope: Olivine, Garnet, Sillimanite, Kyanite, Staurolite, Tourmaline, Enstatite, Diopside, Augite, Actinolite, Hypersthene, Hornblende, Serpentine, Muscovite, Biotite, Quartz and its varieties, Orthoclase, Plagioclase, Microcline, Nepheline, Sodalite, Calcite, Beryl, Talc, Zeolite. Determination of Pleochroic Scheme of minerals. Identification of Plagioclase Feldspars by Michel-Levy method.	30
Experiential Learning: Home Assignments – 8 hrs, Presentation – 8 hrs, Video Screening – 8 hrs		24
Total Notional Credit Hours		**120**

Text Books Suggested:

1) Mineralogy - Dexter Perkins, 3rd edition (2015), Pearson Publication.

Reference Books:

1) Introduction to Optical Mineralogy – William D. Nesse, 3rd edition (2004), Oxford University Press.
2) The Manual of Mineral Science (after James D. Dana) - Dutrow, B., Dwight, J., & Klein, C.; (2007) J. Wiley & Sons.
3) Introduction to Rock Forming Minerals – W. A. Deer, R. A. Howie, and J. Zussman, 3rd edition (2013), Prentice Hall

Type of Course: SEC	Remote Sensing and GIS Credit: 3 L-T-P-C: 2-0-2-3 Scheme of Evaluation: Theory + Practical	Course Code: GEOL162S341

Course Objectives: This course introduces the fundamental principles of remote sensing and Geographic Information Systems (GIS) and their applications in Earth Sciences. The course covers the principles of electromagnetic radiation, remote sensing sensors, and image interpretation techniques. Students will also learn the basic concepts of GIS and spatial analysis.

Course Outcomes	Description	Bloom's Taxonomy
CO 1	Recall basic concepts and facts related to remote sensing and GIS.	**BT 1**
CO 2	Explain the principles and theories behind remote sensing and GIS techniques.	**BT 2**
CO 3	Apply remote sensing and GIS techniques to analyse and interpret spatial data.	**BT 3**
CO 4	Analyse and interpret remotely sensed data to derive meaningful information.	**BT 4**
CO 5	Synthesize their knowledge by mastering thematic mapping and symbology in geology.	**BT 5**

Modules	Topics and Course Content	Hours
Unit 1	Concepts in Remote Sensing, History of Remote Sensing. Sensors, scanners and platforms. Satellites and types. Characteristics of a few Indian Satellites. Indian space missions. Drone surveys of mapping (introduction).	9
Unit 2	Types and acquisition of aerial photographs; Scale and resolution; Principles of stereoscopy, relief displacement, vertical exaggeration and distortion. Elements of aerial photo interpretation; Identification of sedimentary, igneous and metamorphic rocks and various aeolian, glacial, fluvial and marine landforms.	9
Unit 3	Digital Image Processing, Image Errors, Rectification and Restoration. FCC, Image Enhancement, Filtering, Image Rationing. Image classification and accuracy assessment.	9
Unit 4	GIS, Datum, Coordinate systems and Projection systems, Introduction to DEM analysis. GPS: Concepts of GPS; Integrating GPS data with GIS. Applications of GPS in earth system sciences.	9
List of Practical	Aerial Photo interpretation Identification of sedimentary, igneous and metamorphic rocks Identification of various aeolian, glacial, fluvial and marine landforms. Registration of satellite data with a toposheet of the area. Image Processing (analog and digital data) Creation of stereo images from UAV data Determination of elevation from UAV data	30
Experiential Learning: Home Assignments – 8 hrs, Presentation – 8 hrs, Video Screening – 8 hrs		24
Total Notional Credit Hours		**90**

Text Books suggested:

1) De Mars, M. N., 1999: Fundamentals of Geographic Information Systems, John Wiley & Sons Inc., New York.
2) Gopi, S., 2005: Global Positioning System Principles and Applications, Ta McGraw Hill, New Delhi.

Reference Books:

1) Curtis, H., 2000: The GPS Accuracy Improvement Initiative, GPS World, June, 2000.
2) Gonzalez, R. C., Woods, R. E., 2000: Digital Image Processing, Fifth Indian Reprint, Addison Wesley Longman, Delhi.
3) Miller, V. C.,1961: Photogeology; McGraw-Hill, New York.

Detailed Syllabus Of Semester 4

Type of Course: Major	Principles of Stratigraphy Credit: 4 L-T-P-C: 3-0-2-4 Scheme of Evaluation: Theory + Practical	Course Code: GEOL162M441

Course Objectives: This course provides an introduction to the fundamental principles and concepts of stratigraphy. Students will learn about the methods and techniques used to study and interpret the layers of rocks that make up Earth's crust, including the principles of relative and absolute dating, correlation, and stratigraphic nomenclature. The course will also cover the major events and processes that have shaped Earth's geologic history, as recorded in the rock record.

Course Outcomes	Description	Bloom's Taxonomy
CO 1	Students will be able to recall and recognize the basic concepts, principles, and terminology of stratigraphy.	**BT 1**
CO 2	Students will be able to explain the fundamental processes and phenomena that shape the rock record, and the principles and methods used to study and interpret stratigraphic data.	**BT 2**
CO 3	Students will be able to apply stratigraphic principles and techniques to analyse and interpret geologic data and to reconstruct the geologic history of a region.	**BT 3**
CO 4	Students will be able to analyse the spatial and temporal relationships between rock units, and to evaluate the relative ages and depositional environments of these units.	**BT 4**

Modules	Topics and Course Content	Hours
Unit 1	The scope and objectives of stratigraphy The major events and processes that have shaped Earth's geologic history The evolution of life on Earth and its relation to geologic events. The geologic time scale and its subdivisions.	9
Unit 2	Concepts of Lithostratigraphy, Chrono-stratigraphy and Bio-stratigraphy. The principles and guidelines for stratigraphic nomenclature (ICS code of nomenclature). Introductory concepts of sequence stratigraphy, chemo- stratigraphy and magneto-stratigraphy. Global Mass extinction events.	9
Unit 3	Concepts and methods of stratigraphic correlation. The use of biostratigraphy and chemo-stratigraphy in stratigraphic correlation. The Quaternary Period and its divisions, Neogene-Quaternary and Pleistocene-Holocene boundary, the Meghalayan Age.	9
Unit 4	Quaternary stratigraphy- principles and application in Quaternary sequences (Indian examples), soil profile and palaeosol, Quaternary records from marine and continental settings, event stratigraphy. Idea of Quaternary climate changes (glaciation and sea level changes).	9
List of Practicals	Construction of geologic sections and interpretation of stratigraphy. Study of reconstruction of different Proterozoic supercontinents with time. Preparation of fence diagrams from stratigraphic logs. Preparation of stratigraphic columns and their paleo-environment reconstruction.	30
Experiential Learning: Home Assignments – 8 hrs, Presentation – 8 hrs, Video Screening – 8 hrs		24
Total Notional Credit Hours		**90**

Text Books suggested:

1) Stratigraphic Principles and Practices – J. M. Weller; Universal Book Stall, Delhi.
2) Principles of Sedimentology and Stratigraphy, by Sam Boggs, Jr., 4th Edition, Pearson Prentice Hall, 2006.

Reference Books:

1) Stratigraphy: Principles and Methods by Stanley, Steven M.
2) Stratigraphy: A Modern Synthesis by Sloss, L. L.
3) The Geologic Time Scale 2020 by Gradstein, Felix M.
4) Sedimentary Geology: An Introduction to Sedimentary Rocks and Stratigraphy by Prothero, Donald R.
5) Basic Concepts in Sedimentology and Stratigraphy by Nichols, Gary.

Type of Course: Major	Palaeontology Credit: 4 L-T-P-C: 3-0-2-4 Scheme of Evaluation: Theory + Practical	Course Code: GEOL162M442

Course Objectives: Palaeontology is the study of ancient life, focusing on the evolution, diversity, and extinction of organisms over geological time. This course will cover the history and methods of palaeontological research, the principles of evolutionary biology, and the study of fossils as evidence of past life. Topics covered will include the origin and evolution of life, major extinction events, the use of fossils in stratigraphy, and the interpretation of the ecological and biogeographic contexts of ancient ecosystems.

Course Outcomes	Description	Bloom's Taxonomy
CO 1	Students will be able to recall and recognize the key concepts, principles, and facts related to the study of palaeontology	**BT 1**
CO 2	Students will be able to explain the principles of evolutionary biology and the methods used in palaeontological research.	**BT 2**
CO 3	Students will be able to apply palaeontological principles to identify, describe, and interpret the significance of fossils in the context of past life and environments.	**BT 3**
CO 4	Students will be able to analyse the morphology, diversity, and distribution of fossil organisms and their significance in the evolutionary history of life.	**BT 4**

Modules	Topics and Course Content	Hours
Unit 1	Nature and importance of fossil record; Fossilization processes and modes of preservation. Types of fossils (body fossils, trace fossils, leaked fossils, etc.). Importance of Index fossils. Theory of organic evolution as interpreted from fossil record. Speciation, Taxonomic hierarchy. Introduction to Palae-botany and Ichnology.	9
Unit 2	Brief introduction to important invertebrate groups (Bivalvia, Gastropoda, Brachiopoda, Cephalopoda, Foraminifera) and their biostratigraphic significance. Significance of ammonites in Mesozoic biostratigraphy. Functional adaptation in trilobites and ammonoids.	9
Unit 3	Origin of vertebrates and major steps in vertebrate evolution. Brief introduction to vertebrate palaeontology (Hominidae, Equidae, Proboscidae, reptiles). Mesozoic reptiles with special reference to origin, diversity and extinction of dinosaurs.	9
Unit 4	Role of fossils in sequence stratigraphy. Fossils and paleoenvironmental analysis. Fossils and paleobiogeography, biogeographic provinces, dispersals and barriers. Fossils in Hydrocarbon exploration. Fossils in Palaeoclimatic studies.	9
List of Practicals	Identification of fossils in hand specimens. Derivation of evolutionary trend in a given set of fossils. Identification of fossil assemblages and their stratigraphic horizon. Identification of micro-fossils with the help of microscope. Exercises related to fossil spores and pollens.	30
Experiential Learning: Home Assignments – 8 hrs, Presentation – 8 hrs, Video Screening – 8 hrs		24
Total Notional Credit Hours		**90**

Text Books suggested:

1) An Introduction to Palaeontology – Amal Dasgupta, The World Press Private Limited.
2) Palaeontology: (Palaeobiology) Evolution and Animal Distribution – P.C. Jain, M.S. Anantharaman, Vishal Publishing.

Reference Books:

1) Introduction to Paleobiology and the Fossil Record – Michael J. Benton, David A. T. Harper, and Robert L. Carroll, 2nd edition, 2013 by Wiley-Blackwell.
2) Principles of Paleontology - D. M. Raup & S. M. Stanley. W. H. Freeman (1971).
3) Fossils in Earth Sciences – Anis Ray.

Type of Course: Major	Earth Science in Ancient India Credit: 4 L-T-P-C: 3-0-2-4 Scheme of Evaluation: Theory	Course Code: GEOL162M403

Course Objectives: This course aims to explore the rich heritage of earth science in ancient India, delving into the cosmological, geological, and environmental knowledge embedded in Vedic and other ancient Indian texts. By examining the ancient Indian perspectives on the Earth, the solar system, and natural phenomena, students will develop a deeper understanding of the interconnectedness between ancient wisdom and modern scientific principles.

Course Outcomes	Description	Bloom's Taxonomy
CO 1	Students will acquire knowledge of Vedic cosmology and ancient Indian astronomical theories, including the concepts of Lokas, Nakshatras, and the contributions of ancient Indian astronomers to celestial mechanics.	**BT 1**
CO 2	Students will comprehend the geological significance of minerals, metals, and landforms described in ancient Indian texts, as well as the hydrological and geomorphic features of the Sapta Sindhu region.	**BT 2**
CO 3	Students will apply their understanding of ancient Indian tectonic theories and geomantic concepts to interpret the formation of mountains, earthquakes, and architectural principles in Vastu Shastra.	**BT 3**
CO 4	Through the analysis of ancient water management systems and environmental ethics embedded in ancient Indian texts, students will critically evaluate the sustainability and conservation practices advocated by ancient Indian civilization.	**BT 4**

Modules	Topics and Course Content	Hours
Unit 1	**The Earth and the Solar System**: Vedic texts (Rigveda, etc.) for references to cosmology, celestial bodies, and their significance. Understand the concept of Loka (worlds or realms) and the role of the Sun, Moon, and stars. Nakshatras (lunar mansions) and their connection to timekeeping. Works of ancient Indian astronomers such as Aryabhata, Varahamihira, and Brahmagupta: their contributions to understanding planetary motion, eclipses, and celestial coordinates. Siddhantas (astronomical treatises) and their mathematical models.	20
Unit 2	**Earth Materials, Surface Features, and Processes**: Examine ancient Indian texts (e.g., Arthashastra, Manusmriti) for references to minerals, metals, and their uses. Significance of minerals like gold, copper, and iron in ancient trade and economy. Ancient mining techniques and sites of India. Descriptions of landforms in ancient texts. Investigate the Brahmaputra Valley and its geological features. Role of rivers (e.g., Sarasvati, Ganga, Brahmaputra, etc) in shaping the landscape.	20
Unit 3	**Interior of the Earth, Deformation, and Tectonics**: Investigate ancient Indian theories on the formation of mountains and earthquakes. Explore references to Meru, the mythical cosmic mountain, and its geological symbolism. Study ancient texts for accounts of earthquakes (e.g., Lopamudra's prayer in Rigveda). Introduction to Geo-archaeology.	25
Unit 4	**Natural resource management and sustainable livelihood**: Analyse ancient water management systems (e.g., stepwells, irrigation tanks, aqueducts). Understand the importance of water conservation and sustainable practices. References to rainfall patterns and flood control. Description of Sea-level change in ancient texts. Ancient urban planning, sustainable housing, etc.	25
Experiential Learning: Home Assignments – 8 hrs, Presentation – 8 hrs, Video Screening – 8 hrs		24
Total Notional Credit Hours		**90**

Reference Books:

1) "The Lost River: On The Trail of the Sarasvati" by Michel Danino
2) "Vedic Cosmology: Mysteries of the Sacred Universe" by Richard L. Thompson
3) "Astronomy in India: A Historical Perspective" by Mani Bhaumik
4) "Ancient India as Described by Megasthenes and Arrian: Being a Translation of the Fragments of the Indika of Megasthenes" by J. W. McCrindle
5) “Ancient mining techniques and sites of India” By A. K. Grover, Retd. DDG GSI.

Type of Course: Minor	Petrology Credit: 3 L-T-P-C: 2-0-2-3 Scheme of Evaluation: Theory + Practical	Course Code: GEOL162N442

Course Objectives: To provide students with a comprehensive understanding of the formation, classification, and characteristics of igneous, metamorphic, and sedimentary rocks, enabling them to interpret petrological processes and their implications for Earth's geological history and tectonic evolution.

Course Outcomes	Description	Bloom's Taxonomy
CO 1	Students will be able to demonstrate a thorough understanding of the classification, textures, and structures of igneous, metamorphic, and sedimentary rocks, as well as the geological processes responsible for their formation.	**BT 1**
CO 2	Students will be able to interpret and explain the physical and chemical properties of magmas, the factors controlling metamorphism, and the processes involved in weathering and sedimentary flux, demonstrating a deeper comprehension of petrological concepts.	**BT 2**
CO 3	Students will be able to apply their knowledge of petrology to identify and interpret various types of igneous, metamorphic, and sedimentary rocks in hand specimen and thin section, and to relate these observations to geological environments and tectonic settings.	**BT 3**
CO 4	Students will develop the ability to analyse petrological data, including mineral assemblages, textures, and structures, to infer past geological conditions, such as temperature, pressure, and deformation regimes, and to evaluate the processes involved in rock formation and modification.	**BT 4**

Modules	Topics and Course Content	Hours
Unit 1	**Igneous Petrology:** Introduction: Heat flow, geothermal gradient, Physical and chemical properties of magmas. Classification of igneous rocks. Textures and structures of igneous rocks. Mode of occurrence of Igneous rocks. Crystallisation of Magma, Reaction Principle, Magmatic differentiation. Plate tectonics and igneous rock formation.	9
Unit 2	**Metamorphic Petrology:** Definition of metamorphism and Metasomatism. Factors controlling metamorphism. Types of metamorphism - contact metamorphism, regional metamorphism, fault zone metamorphism, impact metamorphism. Index minerals, Metamorphic zones and isograde. Concept of metamorphic facies and grade. Structure and textures of metamorphic rocks. and role of fluids in metamorphism.	9
Unit 3	**Sedimentology:** Weathering and sedimentary flux: Physical and chemical weathering. Sedimentary texture: size, shape, roundness, sphericity, fabric, packing. Concepts of diagenesis, Stages of diagenesis, Compaction and cementation. Textural classification of sediments and sedimentary rocks.	9
Unit 4	Sediment dynamics: Nature of fluid flow – Laminar vs. turbulent flow, concept of flow regime and sediment transport. Sedimentary structures – bedforms and internal stratification. Concept of sedimentary environment and facies.	9
List of Practical	Study of important igneous rocks in hand specimens and thin sections: granite, granodiorite, diorite, gabbro, anorthosites, ultramafic rocks, basalts, andesites, trachyte, rhyolite, dacite. Hand Specimen and Microscopic study of the following metamorphic rocks: a) Serpentinites, albite-epidote-chlorite-quartz schist, slate, talc-tremolite, calcite-quartz schist. b) Gneisses, amphibolite, hornfels, garnetiferous schists, sillimanite-kyanite-bearing rocks, Granulites, eclogite, diopside-forsterite marble.	30

	Grain size analysis of sediments (sieve and pipette method). Study of sedimentary structures in hand specimens. Petrography of clastic and non-clastic rocks through hand specimens and thin sections.	
Experiential Learning: Home Assignments – 8 hrs, Presentation – 8 hrs, Video Screening – 8 hrs		24
Total Notional Credit Hours		**90**

Text Books suggested:

1) Principles of Petrology – G. W. Tyrrell. (1926). Springer
2) Principles of igneous and metamorphic petrology – J. D. Winter (2014). Pearson
3) Introduction to Sedimentology – S. M. Sengupta, (2018), CBS.

Reference Books:

1) Principles of igneous and metamorphic petrology – A. Philpotts & J. Ague. (2009). Cambridge University Press.
2) Principles of igneous and metamorphic petrology – A. Philpotts & J. Ague. (2009). Cambridge University Press.
3) Sedimentary Rocks – F. J. Pettijohn.

Type of Course: Minor	Structural Geology Credit: 3 L-T-P-C: 2-0-2-3 Scheme of Evaluation: Theory + Practical	Course Code: GEOL162N443

Course Objectives: Structural geology is a sub-discipline of geology that deals with the study of deformation and deformation-related structures of rocks at various scales. This course aims to provide a fundamental understanding of structural geology, including the analysis of structural data and the interpretation of deformation processes that occur in the Earth's crust.

Course Outcomes	Description	Bloom's Taxonomy
CO 1	Students will be able to recall the basic concepts, terminology, and principles of structural geology.	**BT 1**
CO 2	Students will be able to comprehend the various types of rock deformation and deformation related structures, including folds, faults, and joints.	**BT 2**
CO 3	Students will be able to apply their knowledge of structural geology to analyze and interpret geological maps and cross-sections.	**BT 3**
CO 4	Students will be able to analyse structural data, including the measurement and plotting of various structural elements, such as strike, dip, and plunge.	**BT 4**

Modules	Topics and Course Content	Hours
Unit 1	Diastrophic and non-diastrophic structures. Structural elements: planar and linear structures, concept of strike and dip, trend and plunge, rake/pitch. Outcrop patterns of different structures.	9
Unit 2	Concept of rock deformation: Stress – normal and shear stress, stress at a point, Stress ellipsoid and principal stress axes, Mohr's stress circle and various stress types. Strain in rocks, types of strain, Principal strain axes and Strain ellipses. Flinn's diagram.	9
Unit 3	Concept of brittle and ductile deformation. Fold morphology; Geometric and genetic classification of folds; Introduction to the mechanics of folding: Buckling, Bending, Flexural slip and flow folding. Description and origin of foliations and lineations.	9
Unit 4	Geometry of pinch and swell and boudin structure. Basic idea of shear zone, faults and joints. Geometric and genetic classification of fractures and faults. Geologic/geomorphic criteria for recognition of faults.	9
List of Practical	Preparation of a topographic profile Drawing profile sections and interpretation of geological maps of different complexities. Structural contouring and 3-point (bore hole) problems of dip and strike. Determination of true thickness of strata from a given exposure. Exercises of stereographic projections of mesoscopic structural data (planar, linear, folded) Exercises on plotting and analysis of linear data in Rose diagram.	30
Experiential Learning: Home Assignments – 8 hrs, Presentation – 8 hrs, Video Screening – 8 hrs		24
Total Notional Credit Hours		**90**

Text Books suggested:

1) Structural Geology - Robert J. Twiss & Eldridge M. Moores, (2nd edition, 2007), W. H. Freeman & Co Ltd.
2) Structural Geology - M. P. Billings, 4th edition, Prentice-Hall.

Reference Books:

1) Foundations of Structural Geology - Park, R. G. (2005), Routledge.
2) Structural Geology – Fundamentals and Modern Developments - S. K. Ghosh, (2013), Elsevier Science.
3) Structural Geology of Rocks and Region - G. R. Davis, (1984), John Wiley.
4) Structural Geology – Haakon Fossen, (2010), Cambridge University Press, New York.