

INDIRA GANDHI UNIVERSITY

MEERPUR- REWARI, HARYANA (122502)

(A State University Established under Haryana Act No.29 of 2013)
(Recognized u/s 12(B) & 2(f) of UGC Act, 1956)

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Scheme of Examination & Syllabus

(in accordance with National Educational Policy 2020)

for

Post Graduate Programme

In

GEOLOGY

Effective from Academic Session 2026-27

Faculty of Earth and Sciences

Indira Gandhi University,

Meerpur-Rewari (122502)

Haryana, India

Details of Approvals

Council/Board	Date	Remark
Staff Council	05.08.2026	
Board of Studies		Circulation Mode
Faculty		
Academic Council		
Year of implementation		



Dean

Faculty of Earth and Space Sciences
(Signature with Stamp)

VISION AND MISSION OF THE UNIVERSITY

VISION

To be a globally renowned university, recognized for excellence in teaching, innovative research, and welfare of the society, imbibing the spirit of “*Vasudhaiv kutumbkam*”.

MISSION

- To introduce and implement innovation in teaching and learning process matching up the global standards to strengthen academic delivery through curriculum design, teaching pedagogy and usage of ICT.
- To develop a mechanism that attracts talented, qualified and experienced faculty from across the globe for pursuing their academic and research careers at the University.
- To offer academic programs at UG, PG, doctoral, Post-Doctoral levels which are learner- centric, industry focused, and adhere to outcome based international models.
- To create an ambiance that is conducive for undertaking sponsored research, innovation and consultancy services to a wide spectrum of societal and industrial requirements while encouraging interdisciplinary approach of learning, team work, and research.
- To establish state of art centres of excellence in frontier areas of research and design innovation through industry collaboration to innovate and incubate the products and services.
- To establish smart campus and promote e-governance activities in the university for the digitally empowered society and knowledge economy.
- To provide a hygienic, modern, environment friendly and vivacious campus attuned to the urgent needs of Green Technology.
- To consider and implement norms, metrics, standards, procedures and benchmarks for assessing and improving the quality in every aspect of University system and achieve quality certifications by National and International bodies.
- To make society self-reliant by organizing various programmes including literacy, gender sensitization, health awareness, and dissemination of information about livelihood generation.

VISION AND MISSION OF THE DEPARTMENT OF GEOLOGY

Vision

To be the center of National importance and International recognition in the field of Geosciences through the educational and research achievements. We are also committed to develop the scientific temperament in our students.

Mission

To equip the students with quality education in Geosciences and inculcate the ethics so that to prepare them for dynamic professional career along with ethical human values.

ABOUT THE PROGRAMME

M.Sc. Geology programme (2 years duration) at Govt. College, Narnaul (Now Affiliated with Indira Gandhi, University, Meerpur, Rewari) was started in 1977 and evolved as one of the pioneer programme as the students from other states came here for their Geological education and got placed in reputed organizations like Geological Survey of India (GSI), Atomic Mineral Directorate (AMD), Oil and Natural Gas Corporation (ONGC), Mines & Geology departments of states, PSUs and MNCs.

MINIMUM ELIGIBILITY CRITERIA

(As per IGU/DHE Haryana Guidelines)

Bachelor of Science (B.Sc.) of three years in any discipline with at least 50% marks (47.5% for SC/ST/Blind/Visually and Differently Abled candidate of Haryana) in aggregate or any examination recognised by Indira Gandhi University, Meerpur, Rewari as equivalent thereto.

PASSING CRITERIA

As per university norms for master programmes of science stream.

ELIGIBILITY FOR EXAMINATION

As per I.G. University norms.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO 1	Prepare graduates with deep, theoretical, and field-based knowledge in core geological sub-disciplines (mineralogy, petrology, structural geology, paleontology, stratigraphy, and geochemistry) integrated with interdisciplinary domain knowledge (geophysics, remote sensing, GIS, data science, and environmental science).
PEO 2	Equip graduates with advanced field-mapping techniques, laboratory analytical methods, remote sensing, spatial modeling, and computational tools.
PEO 3	Train students in the application of geological principles to economic mineral exploration, energy resources (hydrocarbons, geothermal, critical minerals), hydrogeology, and engineering geology.
PEO 4	Instill an understanding of Earth processes in the context of climate change, natural hazards (earthquakes, landslides, floods), oceanography, and environmental conservation in line with local and global sustainability goals.
PEO 5	Foster a research mindset, critical thinking, scientific communication, scientific integrity, and an adaptive learning approach to keep pace with changing technology and global developments.

PROGRAMME LEARNING OUTCOMES (PLOs)

PLO 1	Knowledge	Capable of demonstrating comprehensive disciplinary knowledge gained during course of study.
PLO 2	Research Aptitude	Capability to ask relevant/appropriate questions for identifying, formulating and analysing the research problems and to draw conclusion from the analysis
PLO 3	Communication	Ability to communicate effectively on general and scientific topics with the scientific community and with society at large
PLO 4	Problem-Solving	Capability of applying knowledge to solve scientific and other problems
PLO 5	Individual and Team Work	Capable to learn and work effectively as an individual, and as a member Or leader in diverse teams, in multidisciplinary settings.
PLO 6	Investigation of Problems	Ability of critical thinking, analytical reasoning and research based Knowledge including design of experiments, analysis and interpretation of data to provide conclusions.
PLO 7	Modern Tool Usage	Ability to use and learn techniques, skills and modern tools for scientific Practices.
PLO 8	Scientific temperament	Ability to apply reasoning to assess the different issues related to Society and the consequent responsibilities relevant to the professional scientific Practices.
PLO 9	Life-Long Learning	Aptitude to apply knowledge and skills that are necessary for participating in learning activities throughout life.
PLO 10	Ethics	Capability to identify and apply ethical issues related to one's work, avoid unethical behaviour such as fabrication of data, committing plagiarism and unbiased truthful actions in all aspects of work
PLO 11	Project Management	Ability to demonstrate knowledge and understanding of the scientific principles and apply these to manage projects

Scheme of Examination for Postgraduate Programme	
Subject	Geology
Total number of Semesters	4
Total Marks	2700
Total Credit	26
Framework	2
Scheme	P

Semester	Course Type	Course Code	Nomenclature of course	Theory (T)/ Practical (P)/ Seminar (S)	Credits		Contact hours per week L: Lecture P: Practical S: Seminar				Internal Assessment Marks	End Term Examination Marks	Total Marks	End Term Examination hours
						Total	L	S	P	Total				
1	CC-1	26L6.0-GGY-101	Earth System Science	T	4	26	4	0	0	4	30	70	100	3
	CC-2	26L6.0-GGY-102	Fundamental Geology	T	4		4	0	0	4	30	70	100	3
	CC-3	26L6.0-GGY-103	Physics and Chemistry of the Earth	T	4		4	0	0	4	30	70	100	3
	CC-4	26L6.0-GGY-104	Mineralogy and Crystallography	T	4		4	0	0	4	30	70	100	3
	PC-1	26L6.0-GGY-105	Geology Lab-I (Practical based on 24L6.0-GGY-101, 24L6.0-GGY-102 & Field Work)	P	4		0	0	8	8	30	70	100	3
	PC-2	26L6.0-GGY-106	Geology Lab-II (Practical based on 24L6.0-GGY-103 & 24L6.0-GGY-104)	P	4		0	0	8	8	30	70	100	3
	Seminar	26L6.0-GGY-107	Seminar	S	2		0	0	0	2	0	50	50	1

2	CC-5	26L6.0-GGY-201	Palaeontology and Stratigraphy	T	4	26	4	0	0	4	30	70	100	3
	CC-6	26L6.0-GGY-202	Structural Geology and Tectonics	T	4		4	0	0	4	30	70	100	3
	CC-7	26L6.0-GGY-203	Igneous and Metamorphic Petrology	T	4		4	0	0	4	30	70	100	3
	CC-8	26L6.0-GGY-204	Sedimentology and Geomorphology	T	4		4	0	0	4	30	70	100	3
	PC-3	26L6.0-GGY-205	Geology Lab-III (Practical based on 24L6.0-GGY-201 & 24L6.0-GGY-202)	P	4		0	0	8	8	30	70	100	3
	PC-4	26L6.0-GGY-206	Geology Lab-IV (Practical based on 24L6.0-GGY-203 & 24L6.0-GGY-204)	P	4		0	0	8	8	30	70	100	3
	CHM	26L6.0-CHM-201	Constitutional, Human and Moral values, and IPR	T	2		2	0	0	2	15	35	50	3
	Intern ship	26L6.0-INT-200	An internship course of 4 Credits of 4-6 weeks duration during summer vacation after IInd semester is to be completed by every student. Internship can be either for enhancing the employability or for developing the research aptitude.								50	50	100	-
3	CC-9	26L6.5-GGY-301	Ore Geology and Mineral Economics	T	4	26	4	0	0	4	30	70	100	3
	CC-10	26L6.5-GGY-302	Geohydrology	T	4		4	0	0	4	30	70	100	3
	DEC-1 (Any one from the pool)	26L6.5-GGY-303	Coal and Petroleum Geology	T	4		4	0	0	4	30	70	100	3
		26L6.5-GGY-304	Geoscientific Instrumentation and Analytical Techniques	T	4		4	0	0	4	30	70	100	3
		26L6.5-GGY-305	Isotope Geochemistry	T	4		4	0	0	4	30	70	100	3
		26L6.5-GGY-306	Sequence Stratigraphy	T	4		4	0	0	4	30	70	100	3
	DEC-	26L6.5-GGY-307	Engineering Geology	T	4		4	0	0	4	30	70	100	3

	2 (Any one from the pool)	26L6.5-GGY-308	Computational Geology	T	4		4	0	0	4	30	70	100	3
		26L6.5-GGY-309	Gemology	T	4		4	0	0	4	30	70	100	3
		26L6.5-GGY-310	Geo-Exploration	T	4		4	0	0	4	30	70	100	3
	PC-5	26L6.5-GGY-311	Geology Lab-V (Practical based on 24L6.0-GGY-301, 24L6.0-GGY-302 & Field Work)	P	4		0	0	8	8	30	70	100	4
	PC-6	26L6.5-GGY-312	Geology Lab-VI (Practical based on DEC-1 & DEC-2)	P	4		0	0	8	8	30	70	100	4
	OEC	26L6.5-OEC-GGY-318*	Geoscience and Society*	T	2		2	0	0	2	15	35	50	3
		(*for the students of other than PG Programme Geology) Students of PG Programme Geography will choose from the pool of open elective offered by the university												

4	CC-11	24L6.5-GGY-401	Geoinformatics	T	4	26	4	0	0	4	30	70	100	3
	CC-12	24L6.5-GGY-402	Palaeoecology, Palaeoclimatology and Palaeogeography	T	4		4	0	0	4	30	70	100	3
	DEC-3 (Any one from the pool)	24L6.5-GGY-403	Applied Geochemistry	T	4		4	0	0	4	30	70	100	3
		24L6.5-GGY-404	Oceanography and Marine Geology	T	4		4	0	0	4	30	70	100	3
		24L6.5-GGY-405	Geoheritage, Geoparks and Geotourism	T	4		4	0	0	4	30	70	100	3
		24L6.5-GGY-406	Environmental Geology	T	4		4	0	0	4	30	70	100	3
	DEC-	24L6.5-GGY-407	Mining Geology	T	4		4	0	0	4	30	70	100	3

	4 (Any one from the pool)	24L6.5-GGY-408	Disaster Management	T	4		4	0	0	4	30	70	100	3
		24L6.5-GGY-409	Geomechanics	T	4		4	0	0	4	30	70	100	3
		24L6.5-GGY-410	Field Geology	T	4		4	0	0	4	30	70	100	3
	PC-7	24L6.5-GGY-411	Geology Lab-VII (Practical based on 24L6.0-GGY-401 & 24L6.0-GGY-402)	P	4		0	0	8	8	30	70	100	4
	PC-8	24L6.5-GGY-412	Geology Lab-VIII (Practical based on DEC-3 & DEC-4)	P	4		0	0	8	8	30	70	100	4
	EEC	24L6.5-GGY-413	Entrepreneurship Approaches in Geology	T	2		2	0	0	2	15	35	50	3
OR (Scheme of Semester IV when a student opts for Dissertation or Project Work)														
4	CC-11	24L6.5-GGY-401	Geoinformatics	T	4	26	4	0	0	4	30	70	100	3
	DEC-3 (Any one from the pool)	24L6.5-GGY-403	Applied Geochemistry	T	4		4	0	0	4	30	70	100	3
		24L6.5-GGY-404	Oceanography and Marine Geology	T	4		4	0	0	4	30	70	100	3
		24L6.5-GGY-405	Geoheritage, Geoparks and Geotourism	T	4		4	0	0	4	30	70	100	3
		24L6.5-GGY-406	Environmental Geology	T	4		4	0	0	4	30	70	100	3
	DEC-4 (Any one from the pool)	24L6.5-GGY-407	Mining Geology	T	4		4	0	0	4	30	70	100	3
		24L6.5-GGY-408	Disaster Management	T	4		4	0	0	4	30	70	100	3
		24L6.5-GGY-409	Geomechanics	T	4		4	0	0	4	30	70	100	3
		24L6.5-GGY-410	Field Geology	T	4		4	0	0	4	30	70	100	3
	EEC	24L6.5-GGY-413	Entrepreneurship Approaches in Geology	T	2		2	0	0	2	15	35	50	3
Disser tation/	24L6.5-GGY-414	Dissertation	D	12		0	0	0	-	0	300	300	-	

	Project work													
TOTAL CREDITS						108	TOTAL MARKS						2700	

Part A - Introduction			
Name of Programme	M.Sc. Geology		
Semester	I		
Nature of Course	Theory		
Name of the Course	Earth System Science		
Course Code	26L6.0-GGY-101		
Course Type	CC-1		
Course Level	400-499		
Pre-requisite for the course (if any)	Nil		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO1: Know about the basics of Geoscience and its related disciplines and its relation with mankind.		
	CLO2: Gain knowledge about the basics of dynamic evolution of the Solar system and Earth.		
	CLO3: Understand about the formation of Earth Material.		
	CLO4: Gain knowledge regarding the oceanography and Atmospheric processes.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		3 hours
Part B- Contents of the Course			
Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.			
Unit	Topics	CLO/s Attempt	Contact Hours
I	Earth science: its subdivisions and relation to other sciences. General characteristics and origin of the Universe, Meteorites and Asteroids. Earth's orbital parameters, Kepler's laws of planetary motion. Evolution of Earth, hydrosphere, atmosphere and biosphere. Earth's gravity and magnetic fields and its internal structure: Concept of Isostasy.	CLO 1	15
II	Plate Tectonics: Concept of plate tectonics, sea-floor spreading and continental drift. Geodynamic elements of Earth- Mid Oceanic Ridges, trenches, transform faults and island arcs. Origin of oceans, continents, mountains and rift valleys. Volcanoes- types, products and their distribution.	CLO 2	15
III	Formation of Earth Material: Soil, Minerals, Rocks and Ores; Rock cycle. Geomorphological processes: exogenic processes, weathering, erosion, transportation and deposition by wind, river, glacier, waves and tides. Primary and secondary structures in rocks, behavior of rocks under stress. folds, faults, joints and unconformities- their definition, classification and criteria for recognition in the field and on maps. Shear zones, transform faults, and lineaments.	CLO 3	15
IV	Hypsography of the continents and ocean floor –continental shelf, slope, rise and abyssal plains. Physical and chemical properties of sea water and their	CLO 4	15

spatial variations. Residence times of elements in sea water. Ocean currents, waves and tides, important current systems, thermohaline circulation and the oceanic conveyor belt. Major water masses of the world’s oceans. Biological productivity in the oceans. General circulation of the atmosphere. Climatic and sea level changes on different time scales. Coupled ocean-atmosphere system, El Nino Southern Oscillation (ENSO). General weather systems of India.			
Total Contact Hours			60
Suggested Evaluation Methods			
Internal Assessment: 30		End Term Examination: 70	
• Class Participation:	5	Written Examination: 70 Marks	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		
Part C-Learning Resources			
Recommended Books/e-resources/LMS: Author, Year, title, Publisher, location			
1. Press, F. and Siever, R., 1993. Understanding earth. New York: W.H. Freeman			
2. Moore, J.S. and Wicander, R., 2007, <i>Physical Geology</i> , UK, Belmont, CA.			
3. Hobbs, M.B.E., Means, W.D. and Williams, P.F., 1976, <i>An Outline of Structural Geology</i> , New Jersey, USA, John Wiley & Sons.			
4. Pollard, D.D. and Fletcher, R.C., 2005, <i>Fundamentals of Structural Geology</i> , England, Cambridge University Press.			
5. Billings, M.P., 1972, <i>Structural Geology</i> , Delhi, Prentice Hall India.			
6. Klein, C., Cornelius, S.H., and Dana, J.D., 1848, <i>Danas Manual of Mineralogy</i> , New Jersey, USA, John Wiley & Sons.			
7. Deer, W.A., Howie, R.A. and Zussman, J., 1966, <i>An Introduction to the Rock-Forming Minerals</i> , London, ELBS and Longman.			
8. Read, H.H., 2012, <i>Rutley's Elements of Mineralogy</i> , Heidelberg, Germany, Springer.			
9. Putnis, A., 1992, <i>Introduction to Mineral Sciences</i> , England, Cambridge University press.			

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs)

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁
CLO ₁	3.0	3.0	2.0	1.0	3.0	1.0	3.0	3.0	3.0	2.0	2.0
CLO ₂	3.0	3.0	2.0	1.0	3.0	1.0	3.0	3.0	3.0	2.0	2.0
CLO ₃	3.0	3.0	2.0	1.0	3.0	1.0	3.0	3.0	3.0	2.0	2.0
CLO ₄	3.0	3.0	2.0	1.0	3.0	1.0	3.0	3.0	3.0	2.0	2.0

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	4
Entrepreneurship	4
Skill Enhancement	12
Communication Development	0
Indian Knowledge System	5
Environmental Awareness/SDGs	24
Current Issues and Social Awareness	4
Gender issues	0
Public policies	5
Any Other	8

Part A - Introduction			
Name of Programme	M.Sc. Geology		
Semester	I		
Nature of Course	Theory		
Name of the Course	Fundamental Geology		
Course Code	26L6.0-GGY-102		
Course Type	CC-2		
Level of the course	400-499		
Pre-requisite for the course (if any)	NIL		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO ₁	Understand different aspects of paleontology and stratigraphy.	
	CLO ₂	Get to know about the Mineral Science and Petrology.	
	CLO ₃	Provide knowledge regarding economic geology, mineral exploration and mining.	
	CLO ₄	Understand the impacts of earth processes on environment and society.	
	Theory	Practical	Total
Credits	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Duration (in Hours)	3		
Part B- Contents of the Course			
<u>Instructions for Paper- Setter:</u> The paper setter shall prepare 9 questions selecting two questions from each unit with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory, comprising 7 short answer type questions carrying two marks each (total 14 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt five questions: the compulsory question no. 1 and 1 question from the each of the four units.			
Unit	Topics	CLO/s Attempt	Contact Hours
I	Scope of Geology and its various branches, Geological time scale. life through geological past, major mass extinctions in the geological past. Fossils, fossilization processes (taphonomy), modes of preservation, index fossils and significance of Paleontology. Stratigraphic principles, introduction to lithostratigraphy, biostratigraphy, chronostratigraphy and magnetostratigraphy.	CLO 1	15
II	Broad outline of physiographic and tectonic framework of India. Formation of various types of rocks and their transformations. Emplacement of Igneous rocks, classification of igneous rocks. Sedimentary environment, mineralogy and classification. Metamorphic agents and their effects, mineralogy and classification of metamorphic rocks.	CLO 2	15
III	Basic terms of economic Geology, Classification of ore deposits, processes of formation of ore deposits, Metallogeny and its relation to crustal evolution and tectonism; petroleum and atomic minerals. Concepts of Mineral Prospecting, Exploration & Mining. Depleting natural resources and sustainable development, conservation of mineral	CLO 3	15

	resources,		
IV	Basic principles of environment and ecosystem in relation to Geology. Anthropogenic activities and their impact on the environment. mitigation of pollution and environmental hazards. Elementary idea about Engineering Geology and its significance, geological materials used in construction. Landslides: classification, causes and preventative measures. Fundamentals of field Geology, Importance of Geology for society and National economy.	CLO 4	15
	Total Contact hours		60
Evaluation Methods			
Internal Assessment: 30 Marks		End Term Examination: 70 Marks	
• Class Participation:	5	Written Examination: 70	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		
Part C-Learning Resources			
Recommended Books/e-resources/LMS:			
1. Krishnan, M. S., 1968, Geology of India and Burma, New Delhi, CBS Publishers.			
2. Jain, P.C., Anantharaman, M.S., Palaeontology, 2016, New Delhi, Vishal Publishing Co.			
3. Bateman, A.M., Jensen, M.L., 2013, Economic mineral deposits, USA, John Wiley and Sons.			
4. Gokhale and Rao, 1973, Ore Deposits of India, Delhi, Thomson Press.			
5. Krishnaswami S., 1972, India's mineral resources, New Delhi, Oxford and IBH Pub. Co.			
6. Parmod, A.O., 2009, Handbook of minerals, Crystals, Rocks and Ores, New India Publishing Agency.			
7. Prasad, U., 2010, Economic Mineral Deposits of India, New Delhi, CBS Publishers.			
8. Haque, C. Emdad., D, 2005, Mitigation of Natural hazards and disasters: international perspectives, Heidelberg, Germany, Springer.			
9. Keller, E.A., 2000, Environmental Geosciences, New Jersey, Prentice Hall.			
10. Kumar R., 1985, Fundamentals of Historical Geology and Stratigraphy of India, New Delhi, Wiley Eastern Ltd.			

Mapping of Course Learning Outcomes (CLOs) to Program Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁
CLO ₁	3.0	3.0	2.0	1.0	3.0	1.0	3.0	3.0	3.0	2.0	2.0
CLO ₂	3.0	3.0	2.0	1.0	2.0	1.0	3.0	3.0	1.0	2.0	2.0
CLO ₃	2.0	2.0	2.0	1.0	3.0	1.0	3.0	3.0	3.0	2.0	2.0
CLO ₄	1.0	1.0	2.0	1.0	3.0	1.0	3.0	3.0	3.0	2.0	2.0

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	5
Entrepreneurship	4
Skill Enhancement	10
Communication Development	0
Indian Knowledge System	5
Environmental Awareness/SDGs	36
Current Issues and Social Awareness	6
Gender issues	0
Public policies	5
Any Other	10

Part A – Introduction			
Name of Programme	M.Sc. Geology		
Semester	I		
Nature of Course	Theory		
Name of the Course	Physics and Chemistry of the Earth		
Course Code	26L6.0-GGY-103		
Course Type	CC-3		
Level of the course	400-499		
Pre-requisite for the course (if any)	NIL		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Know about the Earth and its relation to other planets. Importance of Earth science to mankind. CLO 2: Acknowledge earth's interior and the dynamic processes of Earth. CLO 3: Understand the concept of Earth's magnetic field and its application. CLO 4: Understand tectonic evolution of the Himalayas and the Indian shield the significance of geochronology, dating techniques.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		
Part B- Contents of the Course			
Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.			
Unit	Topics	CLO/s Attempt	Contact Hours
I	Theories of origin of Earth: Catastrophic and evolutionary theories. Brief review of knowledge about the solar system. Abundance of the elements in the solar system and earth. The Earth in relation to other planets and major surface features of the Earth. The Earth-Moon system.	CLO 1	15
II	The Earth's interior: the nature of the crust-mantle boundary, low velocity zone in the upper mantle, chemical composition and mineralogy of the Earth's crust, mantle and core, evidence from experimental petrology & study of meteorites, geochemical evolution of the Earth, thermal evolution and state of Earth, continental and oceanic heat flow and convection in mantle.	CLO 2	15
III	Earthquakes, global seismicity, Earth's internal structure derived from seismology, continental drift, earth's magnetic field, origin of geomagnetic fields, paleo-magnetism, polar wandering, sea-floor spreading, plate tectonics, triple junctions, hot spots & plumes.	CLO 3	15
IV	Radioactive decay schemes and their application to geochronology and petro-genesis. Stable isotopes and their application to earth system processes; geochemical differentiation of the earth;	CLO 4	15

geochemical cycles. Geochronology: radiometric dating and its significance, mountain belts and new global tectonics, tectonic evolution of the Himalaya and the Indian shield.			
Total Contact Hours		60	
	Suggested Evaluation Methods		
Internal Assessment: 30		End Term Examination: 70	
Theory	30	Theory:70	
•Class Participation:	5	Written Examination	
•Seminar/presentation/assignment/quiz/class test etc.:	10		
•Mid-Term Exam:	15		
Part C-Learning Resources			
Recommended Books/e-resources/LMS:			
1. Fowler C.M.R., 2004, <i>The Solid Earth</i> , England, Cambridge University Press.			
2. Gauss, I.G., Smith, P.S. and Wilson, R.G.L., 1971, <i>Understanding Earth</i> , Cambridge, MIT Press.			
3. Wyllie, Peter J., 1971, <i>The Dynamic earth - A textbook in Geosciences</i> , New York, Wiley			
4. Jacobs, J.J., Russel, R.D. and Wilson, J.T., 1974, <i>Physics and Geology</i> , New York McGraw Hill.			
5. Schiedegger, A.E., 1974, <i>Fundamental of Geodynamics</i> , Heidelberg, Germany, Springer.			
6. Valdiya, K.S., 1974, <i>Aspects of tectonics: focus on south-central Asia</i> , Mumbai, Tata Mc Graw Hill.			
7. Brown, G.C. and Mussett, A.E., 1993, <i>The Inaccessible Earth</i> , USA, Chapman and Hall.			
8. Brown, J., Hawkesworth, C.,and Wilson, C., 1992, <i>Understanding the Earth</i> , U.S.A. , Siever, R. Frank Press.			
9. Condie, K.C., 1992, <i>Plate Tectonics & Crustal Evolution</i> , USA, Butterworth-Heinemann Ltd.			

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁
CLO ₁	3.0	3.0	2.0	1.0	3.0	1.0	3.0	3.0	3.0	1.0	2.0
CLO ₂	3.0	3.0	2.0	1.0	3.0	1.0	3.0	3.0	3.0	2.0	2.0
CLO ₃	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0	3.0	2.0	2.0
CLO ₄	1.0	3.0	2.0	2.0	3.0	1.0	3.0	2.0	3.0	3.0	2.0

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	5
Entrepreneurship	4
Skill Enhancement	14
Communication Development	0
Indian Knowledge System	5
Environmental Awareness/SDGs	30
Current Issues and Social Awareness	6
Gender issues	0
Public policies	5
Any Other	10

Part A - Introduction			
Name of Programme	M.Sc. Geology		
Semester	I		
Name of the Course	Mineralogy and Crystallography		
Course Code	26L6.0-GGY-104		
Course Type	CC-4		
Level of the course	400-499		
Pre-requisite for the course (if any)	NIL		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Understand crystal systems CLO 2: Recognize optical properties of various mineral groups and its application in various geological techniques. CLO 3: Know about mineral optics and structure. CLO 4: Learn about crystallography and to infer the environment of formation of minerals.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		
Part B- Contents of the Course			
Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.			
Unit	Topics	CLO/s Attempt	Contact Hours
I	Definitions and scope of crystallography in Geoscience, elements of symmetry, notations-Weiss and miller, space lattice: Concept of point group and space group, Morphological classification of crystals into systems and symmetry classes (Holohedral classes). Lattice defects (point, line and planar).	CLO 1	15
II	Minerals - definition and classification, Chemical nature of minerals, Important physical properties of minerals. Structure of silicate minerals: neso-, soro-, cyclo-, iono-, phyllo- and tecto-silicates and their bearing on properties of minerals. Descriptive mineralogy of common rock-forming minerals.	CLO 2	15
III	Optical Mineralogy: Nature of light and principles of optical mineralogy. Observations under plane polarized light and cross polarized light: Extinction angle and its determinations. Interference phenomenon and figures, Uniaxial and biaxial minerals: optical indicatrix. Optic sign. Introduction to the petrological microscope and its use for the identification minerals.	CLO 3	15
IV	Crystal chemistry and bonding concept. Basic concepts of mineral stability with emphasis on solid solution, and exsolution. Transformation of minerals – polymorphism, polytypism, and polysomatism, Twinning in crystals.	CLO 4	15

Total Contact Hours		60
Suggested Evaluation Methods		
Internal Assessment: 30		End Term Examination: 70
➤ Theory	30	Written Examination- 70marks
• Class Participation:	5	
• Seminar/presentation/assignment/quiz/class test etc.:	10	
• Mid-Term Exam:	15	
Part C-Learning Resources		
Recommended Books/e-resources/LMS:		
1. Deer, W.A., Howie, R.A. and Zussman, J., <i>An Introduction to the rock forming minerals</i> , Delhi, Prentice Hall India.		
2. Klein, C., Cornelius, S.H., and Dana, J.D., 1848, <i>Danas Manual of Mineralogy</i> , New Jersey, USA, John Wiley & Sons.		
3. Putnis, A., 1992, <i>Introduction to Mineral Sciences</i> , England, Cambridge University press.		
4. Condie, K.C., 1992, <i>Plate Tectonics & Crustal Evolution</i> , USA, Butterworth-Heinemann Ltd.		
5. Phillips, W.R. and Griffen, D.T., 1986, <i>Optical Mineralogy</i> , New Delhi, CBS Publishers.		
6. Phillips, F.C., 1977, <i>Introduction to crystallography</i> . London, Longman Group Publication.		
7. Klein, C., Cornelius, S.H., and Dana, J.D., 1848, <i>Danas Manual of Mineralogy</i> , New Jersey, USA, John Wiley & Sons.		
8. Read, H.H., 2012, <i>Rutley's Elements of Mineralogy</i> , Heidelberg, Germany, Springer.		
9. Mason, B., Dictrich, 2004, <i>Mineralogy</i> , New Delhi, CBS publishers.		
10. Kerr, P.F., 1942, <i>Optical Mineralogy</i> , New York, McGraw Hill.		

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁
CLO ₁	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₂	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₃	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0
CLO ₄	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	4
Entrepreneurship	4
Skill Enhancement	12
Communication Development	0
Indian Knowledge System	4
Environmental Awareness/SDGs	32
Current Issues and Social Awareness	4
Gender issues	0
Public policies	5
Any Other	16

Part A - Introduction			
Name of the Programme	M.Sc. Geology		
Semester	I		
Name of the Course	Geology Lab-I (Practical based on 26L6.0-GGY-101, 26L6.0-GGY-102 & Field Work)		
Course Code	26L6.0-GGY-105		
Course Type	PC-1		
Level of the course	400-499		
Pre-requisite for the course (if any)	NIL		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO1: Get practical knowledge about fundamental and applied aspects of the petrology. CLO2: Practical knowledge of Palaeontology. CLO3: Learners will get the practical knowledge of Structural Geology. CLO4: Students will get field exposures where they can identify minerals, rocks, structures & their geological observations.		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time	0	3 hours	
Part B- Contents of the Course			
Units	Content	CLO Attempted	Contact Hours
I	Megascopic properties of important rocks in hand specimen. Elementary exercises relevant to recognition of folds, faults and unconformities on maps and in models.	CLO1	30
II	Preparation of geological cross sections from Geological Maps. Megascopic study of important fossils. Study of important stratigraphic rocks in relation to Geological time and mineral deposits.	CLO2	30
III	Use of field instruments viz., clinometer, brunton, prismatic compass, Study of Toposheets, contour maps. a) The following activities will be performed by the students during about one-week Geological Field work and have to submit Field Work Report. Sampling. b) Identification of Minerals, Rocks and Structures.	CLO3	30
IV	c) Preparation of Geological Maps. d) Measurement of Structural Features. And other Geological observations.	CLO4	30
	Total		120
Suggested Evaluation Methods			
Internal Assessment: 30		End Term Examination: 70	
➤ Practicum	30	➤ Practicum	70

• Class Participation:	5	Lab record	10
• Seminar/Demonstration/Viva-voce/Lab records etc.:	10	Viva-Voce	20
• Mid-Term Exam:	15	Write-up	40

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Krishnan, M. S., 1968, Geology of India and Burma, New Delhi, CBS Publishers.
2. Jain, P.C., Anantharaman, M.S., Palaeontology, 2016, New Delhi, Vishal Publishing Co.
3. Bateman, A.M., Jensen, M.L., 2013, Economic mineral deposits, USA, John Wiley and Sons.
4. Gokhale and Rao, 1973, Ore Deposits of India, Delhi, Thomson Press.
5. Krishnaswami S., 1972, India's mineral resources, New Delhi, Oxford and IBH Pub. Co.
6. Parmod, A.O., 2009, Handbook of minerals, Crystals, Rocks and Ores, New India Publishing Agency.
7. Prasad, U., 2010, Economic Mineral Deposits of India, New Delhi, CBS Publishers.
8. Haque, C. Emdad., D, 2005, Mitigation of Natural hazards and disasters: international perspectives, Heidelberg, Germany, Springer.
9. Keller, E.A., 2000, Environmental Geosciences, New Jersey, Prentice Hall.
10. Fowler C.M.R., 2004, *The Solid Earth*, England, Cambridge University Press.
11. Gauss, I.G., Smith, P.S. and Wilson, R.G.L., 1971, *Understanding Earth*, Cambridge, MIT Press.
12. Wyllie, Peter J., 1971, The Dynamic earth - A textbook in Geosciences, New York, Wiley
13. Jacobs, J.J., Russel, R.D. and Wilson, J.T., 1974, Physics and Geology, New York McGraw Hill.
14. Schiedegger, A.E., 1974, Fundamental of Geodynamics, Heidelberg, Germany, Springer.
15. Valdiya, K.S., 1974, Aspects of tectonics: focus on south-central Asia, Mumbai, Tata Mc Graw Hill.
16. Brown, G.C. and Mussett, A.E., 1993, The Inaccessible Earth, USA, Chapman and Hall.
17. Brown, J., Hawkesworth, C., and Wilson, C., 1992, Understanding the Earth, U.S.A. , Siever, R., Frank Press.
18. Condie, K.C., 1992, Plate Tectonics & Crustal Evolution, USA, Butterworth-Heinemann Ltd.

Mapping of Course Learning Outcomes (CLOs) to Program Outcomes & Program Specific Outcomes

CLOs	PO ₁	PO ₂	PO ₃	PO ₄	PO ₅	PO ₆	PO ₇	PO ₈	PO ₉	PO ₁₀	PO ₁₁	PSO ₁	PSO ₂
CLO ₁	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0	3.0	2.0
CLO ₂	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0	3.0	2.0
CLO ₃	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0	2.0	3.0
CLO ₄	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0	2.0	3.0

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	5
Entrepreneurship	6
Skill Enhancement	120
Communication Development	0
Indian Knowledge System	4
Environmental Awareness/SDGs	30
Current Issues and Social Awareness	4
Gender issues	0
Public policies	5
Any Other	12

Part A - Introduction			
Name of the Programme	M.Sc. Geology		
Semester	I		
Name of the Course	Geology Lab-II (Practical based on 26L6.0-GGY-103 & 26L6.0-GGY-104)		
Course Code	26L6.0-GGY-106		
Course Type	PC-2		
Level of the course	400-499		
Pre-requisite for the course (if any)	NIL		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO1: To gain the practical knowledge about the Physics and Chemistry of the Earth. CLO2: Learners will be able to study and interpret geochemical and geophysical data. CLO3: This practical will help in understanding of crystal systems. CLO4: To study of Megascopic and optical properties of various mineral groups and ore minerals.		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time	0	3 hours	
Part B- Contents of the Course			
Units	Content	CLO Attempted	Contact Hours
I	- To draw the internal structure of the Earth, and to demarcate the boundaries of crust, mantle and core. - To draw the tectonic evolution map of Himalaya and explain its different tectonic divisions.	CLO1	30
II	- To draw the seismic maps of India by free hand and its interpretations in context of the geotectonic. - Understanding of crystal systems by using geological models.	CLO2	30
III	Identification of various forms in crystals and to categorized them in system and classes.	CLO3	30
IV	- Observations for the optical properties of Minerals. - Identification of optical properties of various minerals in plane polarized and crossed nicols.	CLO4	30
Total			120
Suggested Evaluation Methods			
Internal Assessment: 30		End Term Examination: 70	
•Class Participation:	5	Lab record	10
•Seminar/Demonstration/Viva-voce/Lab records etc.:	10	Viva-Voce	20
•Mid-Term Exam:	15	Write-up	40

Part C-Learning Resources

1. Deer, W.A., Howie, R.A. and Zussman, J., *An Introduction to the rock forming minerals*, Delhi, Prentice Hall India.
2. Klein, C., Cornelius, S.H., and Dana, J.D., 1848, *Danas Manual of Mineralogy*, New Jersey, USA, John Wiley & Sons.
3. Putnis, A., 1992, *Introduction to Mineral Sciences*, England, Cambridge University press.
4. Condie, K.C., 1992, *Plate Tectonics & Crustal Evolution*, USA, Butterworth-Heinemann Ltd.
5. Phillips, W.R. and Griffen, D.T., 1986, *Optical Mineralogy*, New Delhi, CBS Publishers.
6. Phillips, F.C., 1977, *Introduction to crystallography*. London, Longman Group Publication.
7. Klein, C., Cornelius, S.H., and Dana, J.D., 1848, *Danas Manual of Mineralogy*, New Jersey, USA, John Wiley & Sons.
8. Read, H.H., 2012, *Rutley's Elements of Mineralogy*, Heidelberg, Germany, Springer.
9. Mason, B., Dictrich, 2004, *Mineralogy*, New Delhi, CBS publishers.
10. Kerr, P.F., 1942, *Optical Mineralogy*, New York, McGraw Hill.
11. Gauss, I.G., Smith, P.S. and Wilson, R.G.L., 1971, *Understanding Earth*, Cambridge, MIT Press.
12. Wyllie, Peter J., 1971, *The Dynamic earth - A textbook in Geosciences*, New York, Wiley
13. Jacobs, J.J., Russel, R.D. and Wilson, J.T., 1974, *Physics and Geology*, New York McGraw Hill.
14. Schiedegger, A.E., 1974, *Fundamental of Geodynamics*, Heidelberg, Germany, Springer.

Mapping of Course Learning Outcomes (CLOs) to Program

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁
CLO ₁	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₂	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₃	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0
CLO ₄	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	7
Entrepreneurship	6
Skill Enhancement	120
Communication Development	0
Indian Knowledge System	4
Environmental Awareness/SDGs	30
Current Issues and Social Awareness	4
Gender issues	0
Public policies	5
Any Other	12

Part-I Introduction	
Name of the Programme	M.Sc. Geology
Semester	I
Name of the Course	Seminar
Course Code	26L6.0-GGY-107
Course Type: (CC/DEC/PC/Seminar/CHM/OEC/EEC)	Seminar
Level of the course	400-499
Course Learning Outcomes(CLO) After completing this course, the learner will be able to:	Prepare the power point presentation in an effective manner and to improve communication skills and confidence level.
Credits	Seminar
	2
Teaching Hours per week	2
Max. Marks	50
Internal Assessment Marks	0
End Term Exam Marks	50
Examination Time	30 Minutes
Instructions for Examiner: Evaluation of the seminar will be done by the internal examiner(s) on the parameters as decided by staff council of the department. There will be no external examination/viva-voce examination or As per university's guidelines	

Mapping of Course Learning Outcomes (CLOs) to Program Outcomes & Program Specific Outcomes

CLOs	PO ₁	PO ₂	PO ₃	PO ₄	PO ₅	PO ₆	PO ₇	PO ₈	PO ₉	PO ₁₀	PO ₁₁	PSO ₁	PSO ₂
CLO ₁	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0	3.0	2.0
CLO ₂	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0	3.0	2.0
CLO ₃	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0	2.0	3.0
CLO ₄	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0	2.0	3.0

Part A - Introduction			
Name of Programme	M.Sc. Geology		
Semester	II		
Name of the Course	Palaeontology and Stratigraphy		
Course Code	26L6.0-GGY-201		
Course Type	CC-5		
Level of the course	400-499		
Pre-requisite for the course (if any)	NIL		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Understand different types of fossils and their various uses to mankind. CLO 2: Get to know about the geological time scale and stratigraphic division of India CLO 3: Provide knowledge regarding various types of deposits of ores, petroleum and coal, their distribution and usefulness to mankind. CLO 4: Understand the basics and importance of sustainable development and environmental geology to society.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		
Part B- Contents of the Course			
<u>Instructions for Paper- Setter:</u> The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.			
Unit	Topics	CLO/s Attempt	Contact Hours
I	Vertebrate Palaeontology: Evolution of horse, elephant and man. Invertebrate Palaeontology: Functional morphology and geological history of Brachiopods, Mollusca, Trilobites, Echinoderms and Graptolites. Palaeobotany: General classification of plant kingdom, morphology and classification of Gondwana flora.	CLO 1	15
II	Micropalaeontology: Sampling and sample preparation techniques for microfossils. Morphology, classification, ecology and stratigraphic distribution of Ostracoda, Foraminifera, Conodonts, Radiolarians, Silicoflagellates, and Chitinozoans. Palynology, morphology of Spores and pollen. Application of Microfossils.	CLO 2	15
III	Code of stratigraphic nomenclature, stratigraphic correlation, cyclo-stratigraphy, pedo-stratigraphy, brief introduction to the concepts of sequence stratigraphy. Precambrian Stratigraphy: Dharwar, Cuddapah, Vindhyan and Delhi supergroups.	CLO 3	15

IV	Paleozoic stratigraphy: Spiti and Kashmir. Mesozoic Stratigraphy: Gondwana Supergroup, Deccan Traps, Triassic of Spiti, Jurassic of Kutch, Cretaceous of Trichinopoly. Mesozoic stratigraphy (Spiti, Kutch, and Narmada Valley. Cenozoic stratigraphy of Shimla Himalayas: Siwaliks, Subathu, Dagshai and Kasauli. Indo Gangetic alluvial plains.	CLO 4	15
Total Contact Hours			60
Suggested Evaluation Methods			
Internal Assessment: 30		End Term Examination: 70	
➤ Theory	30	➤ Theory:	70
•Class Participation:	5	Written Examination	
•Seminar/presentation/assignment/quiz/class test etc.:	10		
•Mid-Term Exam:	15		
Part C-Learning Resources			
Recommended Books/e-resources/LMS:			
1. Jain, P.C., Anantharaman, M.S., Palaeontology, 2016, New Delhi, Vishal Publishing Co.			
2. Shukla, A. C., & Misra, S. P., 1975, <i>Essentials of paleobotany</i> . New Delhi, Vikas Publisher.			
3. Clarkson, E.N.K., 1998, <i>Invertebrate Palaeontology and Evolution</i> , UK, Blackwell.			
4. Stearn, C.W. & Carroll, R.L., 1989, <i>Palaeontology- The record of life</i> , USA, John Wiley and Sons.			
5. Prothero, D.R., 2003, <i>Bringing Fossils to Life- An introduction to Palaeobiology</i> , New York McGraw Hill.			
6. Haynes, J.R., 1981, <i>Foraminifera</i> , USA, John Wiley and Sons.			
7. Bignot, G., Graham and Trotman, 1985, <i>Elements of Micropalaeontology</i> , Germany, Springer.			
8. Jones, D.J., 1956, <i>Introduction to Microfossils</i> , UK, Hafner Publishing Co Ltd.			
9. Brasier, M. and Armstrong, H., 2004, <i>Microfossils</i> , UK, Blackwell.			
10. Moore, Lalicker and Fischer, 1952, <i>Invertebrate Fossils</i> , New York, McGraw Hill.			

Mapping of Course Learning Outcomes (CLOs) to Program Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁
CLO ₁	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₂	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₃	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0
CLO ₄	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	5
Entrepreneurship	6
Skill Enhancement	12
Communication Development	0
Indian Knowledge System	4
Environmental Awareness/SDGs	40
Current Issues and Social Awareness	4
Gender issues	0
Public policies	5
Any Other	12

Part A - Introduction			
Name of Programme	M.Sc. Geology		
Semester	II		
Name of the Course	Structural Geology and Tectonics (Theory)		
Course Code	2L6.0-GGY-202		
Course Type	CC-6		
Level of the course	400-499		
Pre-requisite for the course (if any)	Nil		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Learn the concept and tectonics of deformation structures. CLO 2: Know the Kinematics of deformed structures and its significance. CLO 3: Learn the concept of petrofabric analysis and relationship between crystallization and deformation. CLO 4: Understand Himalayan Orogeny, various Map projections and its applicability in field and to the society.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		
Part B- Contents of the Course			
Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.			
Unit	Topics	CLO/s Attempt	Contact Hours
I	Mechanical principles and properties of rocks and their controlling factors. Theory of rock failure. Concept of stress and strain and their relationships of elastic, plastic and viscous materials. Strain markers in naturally deformed rocks. Behavior of minerals and rocks under deformation.	CLO 1	15
II	Fold: mechanics of folding and buckling. Fractures and joints: their nomenclature, age relationship, origin and significance. Causes and dynamics of faulting. Strike-slip faults, normal faults, reverse faults and thrusts, overthrust, nappe, klippe and window. Planar and linear fabrics in deformed rocks, classification and significance. Structural behavior of diapirs and salt domes.	CLO 2	15
III	Concept of petro-fabrics and symmetry: objective, field and laboratory techniques. Types of fabrics. Time relationship between crystallization and deformation.	CLO 3	15
IV	Major tectonic division of Himalaya. Collision of India with Asia. Evolution of Volcanic Island Arc. Indus-Suture Zone. Emergence and evolution of Himalaya. Orogeny, Fore arc basin and Back arc basin. Study of stereographic projection.	CLO 4	15

Total Contact Hours		60
Suggested Evaluation Methods		
Internal Assessment: 30		End Term Examination: 70
➤ Theory	30	Theory: 70
• Class Participation:	5	Written Examination
• Seminar/presentation/assignment/quiz/class test etc.:	10	
• Mid-Term Exam:	15	
Part C-Learning Resources		
Recommended Books/e-resources/LMS:		
1. Ramsay, J.G., 1976, <i>Folding and Fracturing of Rocks</i> , New York, McGraw Hill.		
2. Hobbs, B.E., Means, W.D. and Williams, P.F., 1976, <i>An outline of Structural Geology</i> , USA, John Wiley and Sons.		
3. Davis, G.R., 2013, <i>Structural Geology of Rocks and Region</i> , USA, John Wiley and Sons.		
4. Ramsay, J.G. and Hubber, M.I., 1987, <i>Modern Structural Geology, Volume I & II</i> , USA, Academic Press.		
5. Price, N.J. and Cosgrove, J.W., 1990, <i>Analysis of Geological Structures</i> , England, Cambridge Univ. Press.		
6. Ghosh, S.K., 1993, <i>Structural Geology Fundamentals of Modern Developments</i> , UK, Pergamon Press.		
7. Park, R.G., 1988, <i>Geological Structures and Moving Plates</i> , Germany, Springer science		
8. Keary, P. and Vine, F.J., 2009, <i>Global Tectonics</i> , UK, Blackwell.		
9. Valdiya, K.S., (1998). <i>Dynamic Himalaya</i> , Hyderabad: Universities press.		
10. Summerfield, M.A., (2011). <i>Geomorphology and Global Tectonics</i> , Germany, Springer.		
11. Bayly, B., (1991). <i>Mechanics in Structural Geology</i> , Germany, Springer.		

Mapping of Course Learning Outcomes (CLOs) to Program

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁
CLO ₁	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₂	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₃	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0
CLO ₄	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	4
Entrepreneurship	5
Skill Enhancement	10
Communication Development	0
Indian Knowledge System	4
Environmental Awareness/SDGs	60
Current Issues and Social Awareness	4
Gender issues	0
Public policies	5
Any Other	12

Part A - Introduction			
Name of Programme	M.Sc. Geology		
Semester	II		
Name of the Course	Igneous and Metamorphic Petrology		
Course Code	26L6.0-GGY-203		
Course Type	CC-7		
Level of the course	400-499		
Pre-requisite for the course (if any)	NIL		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Understand concepts of Igneous petrology CLO 2: Learn about metamorphic rocks and their formation. CLO 3: Get knowledge regarding thermodynamics of metamorphic reactions and processes. CLO 4: Learn about petrography of important rock suits of India.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		
Part B-Contents of the Course			
Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.			
Unit	Topics	CLO/s Attempt	Contact Hours
I	Genesis, properties, emplacement and crystallization of magmas. Phase equilibrium studies of simple systems, effect of volatiles on melt equilibria. Differentiation of Magma: Magma -mixing, -mingling and -immiscibility. Classification of Igneous Rocks, Structures and textures of igneous rocks, Descriptive mineralogy of important igneous rocks.	CLO 1	15
II	Metamorphic Petrology: Formation and classification of metamorphic rocks, Metamorphic agents and their effects during metamorphism, protolith types and transformation during metamorphism. Metamorphic structures and textures; Description of common metamorphic rocks. Concept of metamorphic grade, Zones and facies.	CLO 2	15
III	Concept of petrogenetic grid, phase diagrams, geothermobarometry; P-T-t paths and metamorphic reactions. Metamorphism of pelites, mafic -ultra mafic rocks and siliceous dolomites. plate tectonics and metamorphism. Paired metamorphic belts,	CLO 3	15

IV	Petrogenetic aspects of important rock suites of India, such as the Deccan Traps, layered intrusive complexes, anorthosites, carbonatites, charnockites, alkaline rocks, Kimberlites, ophiolites and granitoids.	CLO 4	15
Total Contact Hours		60	
Suggested Evaluation Methods			
Internal Assessment: 30		End Term Examination: 70	
➤ Theory	30	➤ Theory:	70
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		
Part C-Learning Resources			
Recommended Books/e-resources/LMS:			
1. Bucher, K. and Grapes, R., 2010. Petrogenesis of Metamorphic Rocks, Springer.			
2. Fry, N., 1985. Field Description of Metamorphic Rocks, New York, Geological Society of London Handbook Series.			
3. Best, M.G., 2003. Igneous and Metamorphic Petrology, Blackwell Science.			
4. Vernon, R.H., and Clarke G. L. 2008. Principles of Metamorphic Petrology, Cambridge University Press.			
5. 2nd Ed., Winter, J. D. Introduction to Igneous and Metamorphic Petrology. PrenticeHall India, 2010			
6. Yardley, B.W.D., 1997. An Introduction to Metamorphic Petrology, Longman Earth Science			
7. Stuwe, K. (2007) Geodynamics of the Lithosphere. Springer-Verlag,			
8. Philopotts, (A.R. 1994). Principles of Igneous and Metamorphic Petrology, Prentice Hall.			
9. https://egyankosh.ac.in			

Mapping of Course Learning Outcomes (CLOs) to Program Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁
CLO ₁	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₂	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₃	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0
CLO ₄	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	6
Entrepreneurship	8
Skill Enhancement	10
Communication Development	0
Indian Knowledge System	4
Environmental Awareness/SDGs	80
Current Issues and Social Awareness	4
Gender issues	0
Public policies	5
Any Other	12

Part A - Introduction			
Name of Programme	M.Sc. Geology		
Semester	II		
Name of the Course	Sedimentology and Geomorphology		
Course Code	26L6.0-GGY-204		
Course Type	CC-8		
Level of the course	400-499		
Pre-requisite for the course (if any)	NIL		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO1: Understand sedimentary rocks, structures, environments of sedimentation and sedimentary facies in nature. CLO2: Understand characteristics of various sedimentary environments and palaeo-current analysis. CLO3: Know about Field and laboratory methods to study and analyze sedimentary rocks. CLO4: Know about Fundamental concepts of geomorphology and their application in society.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		
Part B- Contents of the Course			
<u>Instructions for Paper- Setter:</u> The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.			
Unit	Topics	CLO/s Attempt	Contact Hours
I	Concept of size, size classification of sedimentary aggregates, causal factors of grain size distribution: provenance, transportation and depositional processes, shape, roundness, porosity and permeability. Sedimentary structures. Maturity of sediments: lithification and diagenesis. Facies.	CLO 1	15
II	Conglomerate types: ortho, para, intraformational. Sandstone types: feldspathic and arkose, lithic, wackes and quartz arenites. Shales and clays. Classification of sandstones. Sedimentological characteristics of fluvial, glacial and aeolian environments. Provenance of sediments, paleocurrent analysis.	CLO 2	15
III	Size analysis of sediments by sieving method, staining technique, X-ray and DTA analysis of clays, heavy mineral analysis and its significance. Application of sedimentary petrology to science, industry and technology. Active tectonic studies of sedimentary basins. Paleochannels of the ancient Saraswati and Drishadvati river systems and	CLO 3	15

	their geological significance.										
IV	Fundamental concepts of geomorphology, base level erosion and peneplanation, cycle concept, rejuvenation and interruption of geomorphic cycle. Climate and geomorphic processes. Factors governing evolution of landforms. Influence of structure and lithology on drainage. Application of geomorphology in civil engineering and strategic terrain evaluation.	CLO 4	15								
Total Contact Hours		60									
Suggested Evaluation Methods											
Internal Assessment: 30		End Term Examination: 70									
➤ Theory	30	➤ Theory:	70								
• Class Participation:	5	Written Examination									
• Seminar/presentation/assignment/quiz/class test etc.:	10										
• Mid-Term Exam:	15										
Part C-Learning Resources											
Recommended Books/e-resources/LMS:											
1. Pettijohn, F.J., (2004) <i>Sedimentary Rocks</i> , New Delhi, CBS Publishers.											
2. <i>Depositional Sedimentary Environments</i> , Reineck and Singh, Springer.											
3. Krumbein, W.C. and Pettijohn, F.J., D., (1938) <i>Manual of Sedimentary Petrography</i> , New York, Appleton Century.											
4. Friedman, Gerald and Sanders, (1938). <i>Principles of Sedimentary deposits: Stratigraphy and Sedimentology</i> , USA: Macmillan.											
5. Shelly, R.C., (1976) <i>Introduction of Sedimentology</i> , Academic Press.											
6. Folk, R.L., (1981). <i>Petrography of Sedimentary rocks</i> , UK, Hemphill Pub. Co.											
7. Carver, R.F., (1971) <i>Procedures in Sedimentary environments</i> , New York, Wiley Interscience.											
8. Pettijohn and Potter, (1971). <i>Palaeocurrent and Basin analysis</i> , Germany: Springer.											
9. Mclane, M., (1995). <i>Sedimentology</i> , USA: Oxford University Press.											
10. Greensmith, J.T., (1988). <i>Petrology of the Sedimentary rocks</i> , Germany: Springer.											
11. Shrock and Robert, R., (1948), <i>Sequence in Layered rocks</i> , New York: McGraw Hill.											
Mapping of Course Learning Outcomes (CLOs) to Program Outcomes											
CLOs	PL O ₁	PL O ₂	PL O ₃	PL O ₄	PL O ₅	PL O ₆	PL O ₇	PL O ₈	PL O ₉	PLO 10	PLO ₁₁
CLO ₁	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₂	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₃	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0
CLO ₄	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	4
Entrepreneurship	5
Skill Enhancement	10
Communication Development	0
Indian Knowledge System	4
Environmental Awareness/SDGs	80
Current Issues and Social Awareness	4
Gender issues	0
Public policies	5
Any Other	15

Part A - Introduction			
Name of the Programme	M.Sc. Geology		
Semester	II		
Name of the Course	Geology Lab-III (Practical based on 26L6.0-GGY-201 & 26L6.0-GGY-202		
Course Code	26L6.0-GGY-205		
Course Type	PC-3		
Level of the course	400-499		
Pre-requisite for the course (if any)	NIL		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO1: To study vertebrate, invertebrate, and plant fossils. And determine the order of geologic events, CLO2: Delineate environmental conditions on the basis of fossil assemblages. CLO3: Preparation of geological cross sections of horizontal, dipping, folded and faulted structures, Preparation. CLO4: Interpretation of geological map and section, Structural problems concerning economic mineral deposits.		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time	0	3 hours	
Part B- Contents of the Course			
Units	Content	CLO Attempted	Contact Hours
I	- Study of rocks from different stratigraphic horizons. - Exercises on stratigraphic correlation. - To determine the order of geologic events.	CLO1	30
II	- Study of vertebrate, invertebrate, and plant fossils. - Processing of samples, picking and mounting of fauna. - Identification and morphological study of the microfossils under microscope.	CLO2	30
III	- Delineation of environmental conditions on the basis of fossil assemblages. - Preparation of geological cross sections from different structural geological maps. - Preparation and interpretation of geological map and section.	CLO3	30
IV	- Structural problems concerning economic mineral deposits. - Plotting and interpretation of petro-fabric data and resultant diagrams, Study of large-scale tectonic features of the earth. - Kinematic analysis of discontinuous planes using stereographic projection.	CLO4	30
Total			120
Internal Assessment: 30		End Term Examination: 70	

• Class Participation:	5	Lab record	10
• Seminar/Demonstration/Viva-voce/Lab records etc.:	10	Viva-Voce	20
• Mid-Term Exam:	15	Write-up	40
Part C-Learning Resources			
1.	Jain, P.C., Anantharaman, M.S., Palaeontology, 2016, New Delhi, Vishal Publishing Co.		
2.	Shukla, A. C., & Misra, S. P., 1975, <i>Essentials of paleobotany</i> . New Delhi, Vikas Publisher.		
3.	Clarkson, E.N.K., 1998, <i>Invertebrate Palaeontology and Evolution</i> , UK, Blackwell.		
4.	Stearn, C.W. & Carroll, R.L., 1989, <i>Palaeontology- The record of life</i> , USA, John Wiley and Sons.		
5.	Prothero, D.R., 2003, <i>Bringing Fossils to Life- An introduction to Palaeobiology</i> , New York McGraw Hill.		
6.	Haynes, J.R., 1981, <i>Foraminifera</i> , USA, John Wiley and Sons.		
7.	Bignot, G., Graham and Trotman, 1985, <i>Elements of Micropalaeontology</i> , Germany, Springer.		
8.	Jones, D.J., 1956, <i>Introduction to Microfossils</i> , UK, Hafner Publishing Co Ltd.		
9.	Brasier, M. and Armstrong, H., 2004, <i>Microfossils</i> , UK, Blackwell.		
10.	Moore, Lalicker and Fischer, 1952, <i>Invertebrate Fossils</i> , New York, McGraw Hill.		
11.	Ramsay, J.G., 1976, <i>Folding and Fracturing of Rocks</i> , New York, McGraw Hill.		
12.	Hobbs, B.E., Means, W.D. and Williams, P.F., 1976, <i>An outline of Structural Geology</i> , USA, John Wiley and Sons.		
13.	Davis, G.R., 2013, <i>Structural Geology of Rocks and Region</i> , USA, John Wiley and Sons.		
14.	Ramsay, J.G. and Hubber, M.I., 1987, <i>Modern Structural Geology, Volume I & II</i> , USA, Academic Press.		
15.	Price, N.J. and Cosgrove, J.W., 1990, <i>Analysis of Geological Structures</i> , England, Cambridge Univ. Press.		
16.	Ghosh, S.K., 1993, <i>Structural Geology Fundamentals of Modern Developments</i> , UK, Pergamon Press.		
17.	Park, R.G., 1988, <i>Geological Structures and Moving Plates</i> , Germany, Springer science		
18.	Keary, P. and Vine, F.J., 2009, <i>Global Tectonics</i> , UK, Blackwell.		
19.	Valdiya, K.S., (1998). <i>Dynamic Himalaya</i> , Hyderabad: Universities press.		
20.	Summerfield, M.A., (2011). <i>Geomorphology and Global Tectonics</i> , Germany, Springer.		
	Bayly, B., (1991). <i>Mechanics in Structural Geology</i> , Germany, Springer.		

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁
CLO ₁	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₂	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₃	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0
CLO ₄	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	4
Entrepreneurship	5
Skill Enhancement	120
Communication Development	0
Indian Knowledge System	4
Environmental Awareness/SDGs	80
Current Issues and Social Awareness	4
Gender issues	0
Public policies	5
Any Other	16

Part A - Introduction			
Name of the Programme	M.Sc. Geology		
Semester	II		
Name of the Course	Geology Lab-IV (Practical based on 26L6.0-GGY-203 & 26L6.0-GGY-204)		
Course Code	26L6.0-GGY-206		
Course Type	PC-4		
Level of the course	400-499		
Pre-requisite for the course (if any)	NIL		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO1: To gain the practical knowledge about Identification of Igneous and Metamorphic rocks. CLO2: Effective presentation and Interpretation of Petrological data. CLO3: To understand the diagenetic and depositional features of sedimentary rocks. CLO4: Practical knowledge of the sedimentological data and paleo-current interpretations.		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time	0	3 hours	
Part B-Contents of the Course			
Units	Content	CLO Attempted	Contact Hours
I	- Drawing and Identification of Igneous forms. - Identification and Description of Igneous rocks.	CLO1	30
II	- Identification of Metamorphic rocks. - Presentation and Interpretation of Data in Igneous and Metamorphic petrology.	CLO2	30
III	- Identification of Sedimentary structures and Rocks. - Identification of Sedimentary environment and provenance.	CLO3	30
IV	- Interpretation of data in Sedimentary petrology. - Paleo-current analysis and interpretation.	CLO4	30
Total			120
Suggested Evaluation Methods			
Internal Assessment: 30		End Term Examination: 70	
•Class Participation:	5	Lab record	10
•Seminar/Demonstration/Viva-voce/Lab records etc.:	10	Viva-Voce	20

•Mid-Term Exam:	15	write-up	40
Part C-Learning Resources			
Recommended Books/e-resources/LMS:			
1. Pettijohn, F.J., (2004) <i>Sedimentary Rocks</i>, New Delhi, CBS Publishers. 2. <i>Depositional Sedimentary Environments</i>, Reineck and Singh, Springer. 3. Krumbein, W.C. and Pettijohn, F.J., D., (1938) <i>Manual of Sedimentary Petrography</i>, New York, Appleton Century. 4. Shelly, R.C., (1976) <i>Introduction of Sedimentology</i>, USA: Academic Press. 5. Folk, R.L., (1981). <i>Petrography of Sedimentary rocks</i>, UK, Hemphill Pub. Co. 6. Carver, R.F., (1971) <i>Procedures in Sedimentary environments</i>, New York, Wiley Interscience. 7. Pettijohn and Potter, (1971). <i>Palaeocurrent and Basin analysis</i>, Germany: Springer. 8. Mclane, M., (1995). <i>Sedimentology</i>, USA: Oxford University Press. 9. <i>Bucher, K. and Grapes, R., 2010. Petrogenesis of Metamorphic Rocks</i>, Springer. 10. Fry, N., 1985. <i>Field Description of Metamorphic Rocks</i>, New York, Geological Society of London Handbook Series. 11. Best, M.G., 2003. <i>Igneous and Metamorphic Petrology</i>, Blackwell Science. 12. Vernon, R.H.,and Clarke G. L. 2008. <i>Principles of Metamorphic Petrology</i>, Cambridge University Press. 13. 2nd Ed., Winter, J. D. <i>Introduction to Igneous and Metamorphic Petrology</i>. PrenticeHall India,2010 14. Yardley, B.W.D., 1997. <i>An Introduction to Metamorphic Petrology</i>, Longman Earth Science			

Mapping of Course Learning Outcomes (CLOs) to Program Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁
CLO ₁	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₂	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₃	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0
CLO ₄	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	4
Entrepreneurship	5
Skill Enhancement	120
Communication Development	0
Indian Knowledge System	4
Environmental Awareness/SDGs	80
Current Issues and Social Awareness	4
Gender issues	0
Public policies	5
Any Other	16

Part A - Introduction			
Name of Programme	M.Sc. Geology		
Semester	III		
Name of the Course	Ore Geology & Mineral Economics		
Course Code	26L6.5-GGY-301		
Course Type	CC-9		
Level of the course	500-599		
Pre-requisite for the course (if any)	NIL		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO1: Understand controls on economic mineral deposits. CLO2: Understand processes of formation of mineral deposits. CLO3: Know about the distribution of economic mineral deposits in India. CLO4: Know about mineral economics and processing of extracted material.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		3 hours
Part B- Contents of the Course			
Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.			
Unit	Topics	CLO Attempted	Contact Hours
I	Concept of ore and gangue, Physico-chemical conditions of ore formation, lithological and structural controls on mineralization, The nature and morphology of the principal types of ore deposit, Classification of ore deposits; Sustainable uses of mineral resources. Metallogeny and its relation to Tectonics and crustal evolution.	CLO 1	15
II	Endogenic processes of ore formation: magmatic ore deposits, volcanic exhalative process. Exogenic processes of ore formation: Mechanical accumulation, sedimentary precipitates, residual concentration, oxidation and supergene enrichment.	CLO 2	15
III	Geology and distribution of important economic deposits of India: Bauxite, iron, manganese, copper, lead, zinc, gold, chromites, diamond, coal, petroleum and nuclear fuel deposits. Marine mineral resources.	CLO 3	15
IV	Mineral Economics: Introduction, Important factors in the economic recovery of minerals, Structure of the mining industry; Ore dressing and beneficiation.	CLO 4	15
Total Contact Hours			60
Suggested Evaluation Methods			

Internal Assessment: 30		End Term Examination: 70
•Class Participation:	5	Written Examination- 70marks
•Seminar/presentation/assignment/quiz/class test etc.:	10	
•Mid-Term Exam:	15	
Part C-Learning Resources		
1. Prasad, U., (2010). Economic Mineral Deposits of India, New Delhi, CBS Publishers. 2. Charles J. Moon, Michael K.G. Whateley & Anthony M. Evans, (2006). Introduction to Mineral Exploration, UK: Blackwell. 3. Parmod, A.O., 2009, Handbook of minerals, Crystals, Rocks and Ores, New India Publishing Agency. 4. Bateman, A.M., Jensen, M.L., 2013, Economic mineral deposits, USA, John Wiley and Sons. 5. Gokhale and Rao, 1973, Ore Deposits of India, Delhi, Thomson Press. 6. Kumar R., 1985, Fundamentals of Historical Geology and Stratigraphy of India, New Delhi, Wiley Eastern Ltd. 7. Craig, J.R. and Vaughan, D.J. (1994) Ore Microscopy and Ore Petrography. USA: John Wiley & Sons 8. Guilbert, J.M. and Park Jr., C.F. (1986) The Geology of Ore deposits. Freeman & Co. 9. Laurence Robb. (2005) Introduction to ore forming processes. Wiley. • 10. Sarkar, S.C. and Gupta, A. (2014) Crustal Evolution and Metallogeny in India. Cambridge Publications.		

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PO ₁	PO ₂	PO ₃	PO ₄	PO ₅	PO ₆	PO ₇	PO ₈	PO ₉	PO ₁₀	PO ₁₁
CLO ₁	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₂	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₃	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0
CLO ₄	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	4
Entrepreneurship	5
Skill Enhancement	120
Communication Development	0
Indian Knowledge System	4
Environmental Awareness/SDGs	80
Current Issues and Social Awareness	4
Gender issues	0
Public policies	5
Any Other	16

Part A - Introduction			
Name of Programme	M.Sc. Geology		
Semester	III		
Name of the Course	Geohydrology		
Course Code	26L6.5-GGY-302		
Course Type	CC-10		
Level of the course	500-599		
Pre-requisite for the course (if any)	Nil		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Know about the basics of geohydrology, water quality and need to focus on surface and groundwater. CLO 2: Gain knowledge about the water bearing properties of rocks and their determination, and concepts and measurement of groundwater flow. CLO 3: Know about characteristics of rocks and soils in relation to groundwater, remote sensing in groundwater studies, groundwater exploration, and water well development and drilling. CLO 4: Gain knowledge regarding the basics and applied aspects of geophysical methods in groundwater exploration.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		
Part B- Contents of the Course			
<u>Instructions for Paper- Setter:</u> The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.			
Unit	Topics	CLO/s Attempt	Contact Hours
I	Introduction to hydrology, geohydrology and hydrogeology, Types of water: meteoric, juvenile, magmatic and sea waters; hydrologic cycle, vertical distribution of water: zone of aeration and zone of saturation; Classification of rocks and formations according to their water-bearing properties. Aquifers and their types. Water table and piezometric surface	CLO 1	15
II	Water bearing properties of rocks and aquifer parameters: porosity, permeability, specific yield, specific retention, hydraulic conductivity, transmissivity, intrinsic permeability, storage coefficient, storativity, specific storage Groundwater flow concepts; Darcy's Law in isotropic and anisotropic media and validity;	CLO 2	15
III	determination of hydraulic conductivity in field and laboratory; methods for constructing shallow wells, drilling wells, well completion; testing wells, pumping test, slug tests for confined and unconfined aquifers; fluctuations in groundwater levels	CLO 3	15

IV	Surface investigation of groundwater- geologic, remote sensing, electrical resistivity, seismic, gravity and magnetic methods; sub-surface investigation of groundwater- test drilling, resistivity logging, spontaneous potential logging, radiation logging. Groundwater quality - physical and chemical properties of water, quality criteria for different uses.	CLO 4	15
Total Contact Hours		60	
Suggested Evaluation Methods			
Internal Assessment: 30		End Term Examination: 70	
➤ Theory	30	➤ Theory:	70
• Class Participation:	5	Written Examination- 70 Marks	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		
Part C-Learning Resources			
Recommended Books/e-resources/LMS:			
1. Davis, S.N. and De Weist, R.J.M. (1966) Hydrogeology, N.Y. John Wiley & Sons Inc.,			
2. Karanth K.R. (1987) Groundwater: Assessment, Development and management, Tata McGrawHill Pub. Co. Ltd.			
3. Todd, D. K. (2006) Groundwater hydrology, 2nd Ed., John Wiley & Sons, N.Y.			
3. Ward, R.C. and Robinson, M., (2011) <i>Principle of Hydrology</i> , Mumbai: Tata McGraw Hill.			
4. Chow, V.T., (1964). <i>Hand Book of applied Hydrology</i> , USA: McGraw Hill.			
5. Heath, R.C. and Trainer, F.W., (1968). <i>Introduction to groundwater hydrology</i> , N.Y. John Wiley and Sons.			
7. Davis, S.N., and Dewiest. R.J.M., 1966) <i>Hydrogeology</i> , N.Y.: John Wiley and Sons.			
8. Toman, C.F., 1937). <i>Ground water</i> , USA: McGraw Hill.			
9. Wister, C.P. & Brater, E.F., (1969) <i>Hydrology</i> , Tokyo: Yoppen Co. Ltd,			
10. Dewiest, R.J.M., (1966) <i>Geohydrology</i> , NY: John Wiley and Sons.			

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁
CLO ₁	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₂	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₃	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0
CLO ₄	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	4
Entrepreneurship	5
Skill Enhancement	20
Communication Development	0
Indian Knowledge System	4
Environmental Awareness/SDGs	70
Current Issues and Social Awareness	4
Gender issues	0
Public policies	6
Any Other	18

Part A - Introduction			
Name of Programme	M.Sc. Geology		
Semester	III		
Name of the Course	Coal and Petroleum Geology		
Course Code	26L6.5-GGY--303		
Course Type	DEC-1		
Level of the course	500-599		
Pre-requisite for the course (if any)	NIL		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO1: Understand the process of formation of coal and its composition. CLO2: Understand the utilisation of coal and its impact on environment. CLO3: Understand the process of formation hydrocarbon in nature. CLO4: Understand the Applications of microfossils in hydrocarbon exploration.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		3 hours
Part B- Contents of the Course			
Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.			
Unit	Topics	CLO/s Attempt	Contact Hours
I	Introduction to coal, theories of origin of coal, process of coalification. Proximate and ultimate analyses of coal; lithotypes, macerals and micro-lithotypes of coal, coal gasification, coal carbonization and coal liquefaction.	CLO 1	15
II	Geological and geographical distribution of coal deposits in India, Coal as a source of hydrocarbon. Coal Bed Methane (CBM). Coal mining and its impact on the environment.	CLO 2	15
III	Kerogen, its composition and origin, transformation of organic matter, diagenesis, ketagenesis and metagenesis. Nature of migration of oil and gas, characteristics of reservoir rocks and traps. Major oil and gas fields of India.	CLO 3	15
IV	Hydrocarbon source rock evaluation. Biogenic and thermogenic hydrocarbons. Applications of microfossils in hydrocarbon exploration. Unconventional Resources: oil shale, shale gas, tar sands, gas hydrates. Fractional distillation of petroleum. Environmental impact of hydrocarbons.	CLO 4	15

Total Contact Hours		60
Suggested Evaluation Methods		
Internal Assessment: 30		End Term Examination: 70
● Class Participation:	5	Written Examination- 70marks
● Seminar/presentation/assignment/quiz/class test etc.:	10	
● Mid-Term Exam:	15	
Part C-Learning Resources		
1. Tissot, B.P. and Welte, D.H. (1984) <i>Petroleum formation and occurrence</i>, Springer-Verlag 2. Selley, R.C., (1998) <i>Elements of Petroleum Geology</i>, Academic Press. 3. Ward, C.R. (1984) <i>Coal Geology and Coal Technology</i>, Blackwell Scientific, Australia. 4. Kumarmangalam, S.M. (1973) <i>Coal Industry in India</i>, Oxford and IBH. 5. Levorsen, A. (1967). <i>Geology of Petroleum</i>, San Francisco: W.H. Freeman and Company. 6. Hunt, J.M., (1996). <i>Petroleum Geochemistry and Geology</i>, 2nd Edn, San Francisco: W.H. Freeman and Company. 7. North, F.K., (1985) <i>Petroleum Geology</i>, USA: Unwin Hyman (Pub.). 8. Richard, C. Selley, (2022). <i>Elements of Petroleum Geology</i>, London: Academic Press. 9. Chapman, R.E. (1983) <i>Petroleum Geology</i>. Elsevier, Amsterdam. 10. Hobson, G.D. (1977) <i>Developments in Petroleum Geology</i>, (Ed.), Applied Science Publishers, London. 11. Chandra, D., Singh, R.M. and Singh, M.P., (2000) <i>Textbook of coal</i> (Indian Context), Tata Book Agency, Varanasi.		

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁
CLO ₁	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₂	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₃	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0
CLO ₄	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	4
Entrepreneurship	5
Skill Enhancement	70
Communication Development	0
Indian Knowledge System	4
Environmental Awareness/SDGs	90
Current Issues and Social Awareness	4
Gender issues	0
Public policies	5
Any Other	20

Part A - Introduction			
Name of Programme	M.Sc. Geology		
Semester	III		
Name of the Course	Geoscientific Instrumentation and Analytical Techniques		
Course Code	26L6.5-GGY-304		
Course Type	DEC-1		
Level of the course	500-599		
Pre-requisite for the course (if any)	NIL		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Gain knowledge about the evolution of technology and instrumentation in the field of Geosciences. CLO 2: knowledge about various sample and slide preparation as well as remote sensing and GIS technique. CLO 3: learn about sedimentology techniques and various spectrometry and spectroscopy. CLO 4: learn about groundwater and engineering geology techniques.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		3 hours
Part B-Contents of the Course			
<u>Instructions for Paper- Setter:</u> The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course-learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.			
Unit	Topics	CLO/s Attempt	Contact Hours
I	Introduction: uses of analytical techniques, evolution with technological development, importance of sophisticated instruments and accurate analysis. Sample and sampling in geosciences, modal count techniques, techniques of photography in geosciences.	CLO 1	15
II	Preparation thin section and polished section making: cutting, grinding and polishing; powder sample preparation crushing & pulverizing. Techniques in microfossils slide preparation. Remote sensing and GIS techniques: aerial photograph studies, image interpretation and classification techniques.	CLO 2	15
III	Sedimentological techniques: sieves & sieve shaking. Sample etching & staining, heavy minerals & clay minerals methods, size & shape of sediments studies. Geochemistry techniques: flame photometer, UV spectrophotometer, (AAS) Atomic Absorption Spectrophotometry,	CLO 3	15

	ICP-Mass spectrometry, X-ray fluorescence spectrometry, Electron microscopy and electron-probe microanalysis, cathodoluminescence & thermoluminescence spectrometry.		
IV	Engineering geology techniques & instrumentation: in-situ and lab testing of strength of materials. Hydrogeological techniques & instrumentation: groundwater flow measurement, water quality measurement and water harvesting systems. Geophysical instrumentations: principles, working and data acquisition.	CLO 4	15
Total Contact Hours		60	
Suggested Evaluation Methods			
Internal Assessment: 30		End Term Examination: 70	
•Class Participation:	5	Written Examination- 70 Marks	
•Seminar/presentation/assignment/quiz/class test etc.:	10		
•Mid-Term Exam:	15		
Part C-Learning Resources			
Recommended Books/e-resources/LMS:			
1 Hutchinson, C. S., (1974). <i>Laboratory handbook of petrographic techniques</i> , USA, John Wiley.			
2 Hugh R., (2021) <i>Using geochemical data</i> , Cambridge University Press.			
3 Alam Singh, (1987). <i>Modern geotechnical engineering</i> , New Delhi, CBS Publishers.			
4 Ramakrishna, TS (2006). Memoir 62: Geophysical Practice in Mineral Exploration and Mapping. Journal of Geological Society of India, 67(6), 801–801.			
5 Telford, W.M., Geldart, L.P. and Sheriff, R.E., (1990), "Applied Geophysics", Cambridge University Press.			
6 Kearey, P. Brooks, M. and Hill, I.,(2002). "An Introduction to Geophysical Exploration: Blackwell.			
7 Lowrie, W. (2007) “Introduction to Geophysics” Cambridge University Press,			
8 Lillie, R.J. (1998). “Whole Earth Geophysics” London: Pearson Publication.			
9 Fowler; C.M.R. (1991). An introduction to Global Geophysics. UK: Cambridge University Press.			
10 Parasnis, D.S., (1997). "Principles of Applied Geophysics", London: Champan and Hall.			
11 Dobrin, M.B. & Savit, C.H. (1988) Introduction to Geophysical prospecting, McGraw Hill, New York.			
12 Serra, O, (1984) Fundamentals of well-log interpretation volume, New York, Elsevier.			

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁
CLO ₁	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₂	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₃	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0
CLO ₄	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	4
Entrepreneurship	5
Skill Enhancement	40
Communication Development	0
Indian Knowledge System	4
Environmental Awareness/SDGs	100
Current Issues and Social Awareness	60
Gender issues	0
Public policies	5
Any Other	16

Part A - Introduction			
Name of Programme	M.Sc. Applied Geology		
Semester	III		
Name of the Course	Isotope Geochemistry		
Course Code	26L6.5-GGY--305		
Course Type	DEC-1		
Level of the course	500-599		
Pre-requisite for the course (if any)	NIL		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 305.1: Know about fundamentals of isotope geochemistry. CLO 305.2: Acknowledge the radiogenic isotope systems and geochronology CLO 305.3: Understand the principle and application of stable isotope geochemistry. CLO 305.4: Understand the application of isotope geochemistry in earth and planetary sciences.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		3 hours
Part B- Contents of the Course			
Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.			
Unit	Topics	CLO/s Attempt	Contact Hours
I	Introduction to isotope geochemistry. Concept of isotopes: Stable vs. Radiogenic isotopes. Atomic structure, isotopic fractionation, and mass spectrometry. Principles of radiogenic and stable isotope systems. Decay schemes, half-life, and radioactive equilibrium. Applications of isotopic systems in geochemistry	CLO 1	15
II	Principles of radiometric dating. Decay schemes: U-Pb, Rb-Sr, Sm-Nd, K-Ar, Ar-Ar, and Fission track dating. Closure temperature and interpretation of isotopic ages. Isochron method and error analysis. Applications of radiogenic isotopes in crustal evolution, magma genesis, and metamorphism.	CLO 2	15
III	Principles of stable isotope fractionation (equilibrium and kinetic effects). Oxygen (O), Hydrogen (H), Carbon (C), Nitrogen (N), and Sulfur (S) isotopes in geological	CLO 3	15

	processes. Applications in hydrology, paleoclimate studies, and biogeochemical cycles. Isotope geochemistry of fluids, carbonates, and organic matter. Isotopic variations in different geological reservoirs (mantle, crust, atmosphere, hydrosphere)		
IV	Isotopic constraints on mantle and crustal evolution. Isotopic evidence for planetary differentiation and meteorites. Biogeochemical cycling of isotopes in the Earth system. Environmental and forensic applications of isotopes. Recent advancements in isotope geochemistry	CLO 4	15
Total Contact Hours		60	
Suggested Evaluation Methods			
Internal Assessment: 30		End Term Examination: 70	
• Class Participation:	5	Written Examination- 70marks	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		
Part C-Learning Resources			
Recommended Books/e-resources/LMS:			
1. Mason, B. and Moore, C.B., 1991, <i>Introduction to Geochemistry</i> , Wiley Eastern.			
2. <i>Krauskopf, K.B., 1967, Introduction to Geochemistry</i> , McGraw Hill.			
3. Faure, G., 1986, <i>Principles of Isotope Geology</i> , John Wiley & Sons.			
4. Hoefs, J., 1980, <i>Stable Isotope Geochemistry</i> , Springer-Verlag.			
5. Wedepohl, K. H. 1971; <i>Geochemistry</i> . USA: Holt, Rinehart & Winston.			
6. <i>Brownlow A.H. (1996) Geochemistry, Second Edition, Prentice Hall, New Jersey.</i>			
7. <i>Henderson, P. 1982 Inorganic Geochemistry. Oxford. Pergamon Press.</i>			
8. Nordstrom, D.K. and Munoz, J.L. (1986) <i>Geochemical Thermodynamics</i> . Blackwell Scientific Publications, New York.			
9. Govett, G.J.S., (1983). <i>Hand book of Exploration Geochemistry</i> , Elsevier.			
10. Faure, G. and Mensing, T. M., (2005) <i>Isotopes: Principles and Applications</i> , John Wiley & Sons,			
11. Dickin, A. P., (1995) <i>Radiogenic Isotope Geology</i> , Cambridge University Press.			
12. White, M. William, (2014) <i>Isotope Geochemistry</i> , Wiley – Blackwell.			

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁
CLO ₁	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₂	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₃	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0
CLO ₄	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	80
Entrepreneurship	60
Skill Enhancement	40
Communication Development	0
Indian Knowledge System	4
Environmental Awareness/SDGs	100
Current Issues and Social Awareness	60
Gender issues	0
Public policies	5
Any Other	16

Part A - Introduction			
Name of Programme	M.Sc. Geology		
Semester	III		
Name of the Course	Sequence Stratigraphy		
Course Code	26L6.5-GGY--306		
Course Type	DEC-1		
Level of the course	500-599		
Pre-requisite for the course (if any)	NIL		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO1: Understand the basic principles and concepts of sequence stratigraphy. CLO2: Understand different types of stratigraphy and interpret the various boundaries. CLO3: Understand different Systems tracts and Parasequences. CLO4: Use sequence stratigraphy for basin analysis and petroleum exploration.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		3 hours
Part B- Contents of the Course			
<u>Instructions for Paper- Setter:</u> The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.			
Unit	Topics	CLO/s Attempt	Contact Hours
I	Definition & overview of sequence stratigraphy. History and concepts of sequence stratigraphy. Basic stratigraphic principles. Overview of global sea-level change and its impact on sedimentation.	CLO 1	15
II	Different types of stratigraphy: lithostratigraphy, biostratigraphy, chronostratigraphy, and seismic stratigraphy. Unconformities and sequence boundaries.	CLO 2	15
III	Introduction to Sequence Boundaries (SB), Transgressive Surfaces (TS), and Maximum Flooding Surfaces (MFS). Systems tracts (lowstand systems tract, transgressive systems tract, highstand systems tract, falling-stage systems tract). Parasequences and parasequence sets.	CLO 3	15

IV	Depositional environments (Shorelines, deltas, shelf, deep water). Well log correlation and interpretation in sequence stratigraphy. Paleoenvironmental reconstruction using sequence stratigraphy. Application of Sequence Stratigraphy in hydrocarbon exploration.	CLO 4	15
Total Contact Hours			60
Suggested Evaluation Methods			
Internal Assessment: 30		End Term Examination: 70	
• Class Participation:	5	Written Examination- 70marks	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		
Part C-Learning Resources			
Recommended Books/e-resources/LMS:			
1 Catenuanu, O., (2014), Principles of Sequence Stratigraphy, Netherland: Elsevier, Amsterdam			
2 Emery, D. and Myers, K.J., (1996) Sequence Stratigraphy, U.K. Blackwell,			
3 Miall, A.D., (2009), The Geology of Stratigraphic Sequences, Berlin: Springer-Verlag,			
4 Miall, A.D., (2010), Principles of Sedimentary Basin Analysis, 3rd edition, Berlin: Springer-Verlag,			
5 Payton, C.E., (1977), Seismic Stratigraphy- Applications to Hydrocarbon Exploration, Memoir of the American Association of Petroleum Geologists 26, Tulsa, Oklahoma.			
6 Vail, J. L. and Hardenbol S. M., (2011): Sequence Stratigraphy: Methodology and Applications.			
7 Posamentier, H. W., (2009), Sequence Stratigraphy and Facies Associations, Willey.			
8 Nichols, G., (2009). Sedimentology and Stratigraphy, Willey Blackwell.			
9 Jain, P.C., Anantharaman, M.S., Palaeontology, 2016, New Delhi, Vishal Publishing Co.			
10 Brasier, M.D. (1980) Microfossils. George Allen and Unwin, London.			
11 Boggs, Sam Jr. (2013). Principles of Sedimentology and Stratigraphy Pearson Education,			

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁
CLO ₁	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₂	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₃	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0
CLO ₄	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	4
Entrepreneurship	5
Skill Enhancement	40
Communication Development	0
Indian Knowledge System	4
Environmental Awareness/SDGs	100
Current Issues and Social Awareness	60
Gender issues	0
Public policies	5
Any Other	16

Part A - Introduction			
Name of Programme	M.Sc. Geology		
Semester	III		
Name of the Course	Engineering Geology		
Course Code	26L6.5-GGY-307		
Course Type	DEC-2		
Level of the course	500-599		
Pre-requisite for the course (if any)	NIL		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Understand Soil and rock mechanics. CLO 2: Get to know about Identification and classification of soil properties and soil types. CLO 3: Provide knowledge regarding Investigation and analyses of construction materials, Application of Geology in civil engineering CLO 4: Learn about investigating landslides, slope stability studies, engineering geological applications in assessment of hazard zonation, earthquake, landslide and flood mitigation, engineering geological mapping.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		3 hours
Part B- Contents of the Course			
Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course-learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.			
Unit	Topics	CLO/s Attempt	Contact Hours
I	Mechanics of rocks- compressive and shear strength, modulus of elasticity, Poisson's ratio, residual stresses, engineering properties of rocks, bearing strength of foundations, strength of discontinuities. Rock mass classification: rock quality design index, rock structure rating, rock mass ratings, rock tunnel quality index, rock mass index and geological strength index.	CLO 1	15
II	Mechanics of soils- soil profile, soil description and classifications, Atterberg's limits, porosity, permeability and weathering, swelling and pore pressure of soils, cohesion and friction of soil, shear strength of soils, Mohr's envelope, engineering geological characteristics of sediments and problematic soils.	CLO 2	15
III	Construction materials in practice. Dam: types and their foundations, case histories. Tunnel: classification, method of tunneling and case histories. Application of geological and geophysical methods in civil engineering projects. Role of engineering Geology in planning, designing and constructions of civil engineering projects: dam, tunnel, rail, road and highways, bridges and building.	CLO 3	15

IV	Landslides, types of rock slope failures, slope stability assessment, Slope mass ratings, causes and consequences of earthquakes and landslides on engineering structures and preventive/mitigation measures, river improvement and flood control. Engineering geological maps.	CLO 4	15
Total Contact Hours		60	
Suggested Evaluation Methods			
Internal Assessment: 30		End Term Examination: 70	
• Class Participation:	5	Written Examination- 70marks	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		
Part C-Learning Resources			
Recommended Books/e-resources/LMS:			
1. Krynine and Judd, (2005), <i>Engineering Geology</i> , New Delhi, CBS publishers.			
2. Lambe, T.W. and Whitman, R., (2005) <i>Soil mechanics</i> , Wiley India Pvt Ltd.			
3. Bharath Singh and Shamser, (1990) Prakash <i>Soil mechanics and foundation engineering, India:</i> Nem Chand and Bros.			
4. Tsytovich, N.A., (1976) <i>Soil mechanics</i> , Central Books Ltd.			
5. Udall, S.L. and Dominy, F.E., (1987) <i>Design of small dams</i> , United States Govt. Printing Office.			
6. Blyth, F.G.H. and Freitas, M., (1984). <i>Manual of Engineering Geology</i> , CRC Press.			
7. Luis González de Vallejo and Ferrer, M., (2011). <i>Geological Engineering</i> , CRC Press.			
8. Bhawani Singh and R. K. Goel. (1999) <i>Rock Mass Classification: A Practical Approach in Civil Engineering</i> , Elsevier Science.			
9. Jaeger J. C., Cook N. G. W., and Zimmerman R. W, (2019) <i>Rock Mechanics an Introduction</i> , CRC Press.			

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁
CLO ₁	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₂	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₃	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0
CLO ₄	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	60
Entrepreneurship	50
Skill Enhancement	60
Communication Development	0
Indian Knowledge System	4
Environmental Awareness/SDGs	100
Current Issues and Social Awareness	60
Gender issues	0
Public policies	5
Any Other	16

Part A - Introduction			
Name of Programme	M.Sc. Geology		
Semester	III		
Name of the Course	Computational Geology		
Course Code	26L6.5-GGY--308		
Course Type	DEC-2		
Level of the course	500-599		
Pre-requisite for the course (if any)	Nil		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO1: Know about the role of mathematical techniques in geo-sciences with a quick rewind of basic computer concepts. CLO2: Gain knowledge about various methods of data handling and representation. CLO3: Get knowledge of basic concepts of computer language and graphical representation of data. CLO4: Know about statistical techniques and their application in geology.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours	0	3 hours
Part B- Contents of the Course			
Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.			
Unit	Topics	CLO/s Attempt	Contact Hours
I	Role of mathematical and numerical techniques in geo-sciences, qualitative and quantitative data in geology; application of computer in general database of geology. Computer system hardware: operating system, DOS and its use.	CLO 1	15
II	Spreadsheets: workbook, worksheet, cell and cell reference, type of data, Functions and formulas, cell range and reference in formula; protecting worksheets; sorting and filtering data; Utility of open source and other common softwares in calculating statistical parameters and presenting them in graphic manner.	CLO 2	15
III	Graphs: collection and selection of data, linear and logarithmic scale, linear graphs, 2d and 3d graphs, bar graphs, scatter plots, pie diagrams etc, use of graphs in geoscience. Data types, expressions and statements, interactive statements, input/output statements subroutine and functions. Utility of Google-Earth software in understanding earth features and geomorphic-tectonic units.	CLO 3	15
IV	Statistical techniques: mean, mode, median, cumulative frequency distribution, skewness & kurtosis, graphical representation on histograms and curves, regression analysis, linear regression, correlation and	CLO 4	15

correlation coefficients, application of these methods in geology.			
Total Contact Hours		60	
Suggested Evaluation Methods			
Internal Assessment: 30		End Term Examination: 70	
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		
Part C-Learning Resources			
Recommended Books/e-resources/LMS:			
1. Borradaile, G.J., (2003). <i>Statistics of Earth science Data</i> , Springer.			
2. K., Han John, W., (2003). <i>Elementary Numerical Analysis</i> , Atkinson John Wiley & Sons.			
3. Yang, W.Y., Cao, W., Chung, T.S., (2005). <i>Applied Numerical Methods</i> , John Wiley & Sons.			
4. W.H., Teukolsky, S.A., Vellerling, W.T., Flannery,B.P., (1992). <i>Numerical Recipes: The Art of Scientific Computing</i> , Press, Cambridge University Press.			
5. Davis, J.C., (2002). <i>Statistics and Data Analysis in Geology</i> , 3rd Ed., John Wiley & Sons.			
6. Rajaraman, V., (1999). <i>Computer Oriented Numerical Methods</i> , Prentice Hall of India.			
7. e-PG Pathshala,			
8. Geology Notes by IGNOU.			
9. Geology study material quadrant by ECE			

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁
CLO ₁	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₂	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₃	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0
CLO ₄	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	50
Entrepreneurship	70
Skill Enhancement	60
Communication Development	0
Indian Knowledge System	4
Environmental Awareness/SDGs	100
Current Issues and Social Awareness	60
Gender issues	0
Public policies	5
Any Other	14

Part A - Introduction			
Name of Programme	M.Sc. Geology		
Semester	III		
Name of the Course	Gemology		
Course Code	26L6.5-GGY--309		
Course Type	DEC-2		
Level of the course	500-599		
Pre-requisite for the course (if any)	Nil		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Know about the basics of gemology and its significance. CLO 2: Identify and classify rocks and minerals based on various physical properties required for being termed as gemstones. CLO 3: Get to know regarding the distribution of gems in India and world. CLO 4: Gain knowledge regarding the instruments and the techniques applicable in the field.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		3 hours
Part B-Contents of the Course			
<u>Instructions for Paper- Setter:</u> The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.			
Unit	Topics	CLO/s Attempt	Contact Hours
I	Physical properties of gems: hardness, color and their causes, transparency, lusture, Mohs scale, cleavage, parting, fracture, specific gravity. Magnetism, pyro-electricity, piezoelectricity and radioactivity in gems. Morphology of crystals.	CLO 1	15
II	Basic qualities of gems and gem optics: pleochroism, interference, dispersion, reflection, refraction, strain. Sheen, chatoyancy, asterism, iridescence, adularescence, aventury scence, opalescence.	CLO 2	15
III	Semi-precious, organic and other varieties of gemstones. Various cuts and shapes in gems. Occurrences of precious and semi-precious gemstones in India and world.	CLO 3	15
IV	Gemological instruments and their principle: jewellers lens, microscopes, spectroscope, dichroscope, polariscope, refractometer, UV lamps, Chelsea filter, thermal probes. Advanced gemological instruments: FTIR, Raman spectroscope, Diamond SURE, Diamond VIEW.	CLO 4	15
Total Contact Hours			60

Suggested Evaluation Methods		
Internal Assessment: 30		End Term Examination: 70
• Class Participation:	5	Written Examination
• Seminar/presentation/assignment/quiz/class test etc.:	10	
• Mid-Term Exam:	15	
Part C-Learning Resources		
Recommended Books/e-resources/LMS: 1. Richard, T. Liddicoat, (1981). <i>Hand book of gem identification</i> , Gemological Institute of America. 2. Anton Skuratowicz and Julie Nash, (2005). <i>Working with gemstones</i> , MJSA/AJM Press. 3. Colin H. Winter and Hilary Taylor, (2003). <i>A Students' Guide to Spectroscopy</i> , OPL Press. 4. Antoinette, Matlins. (1997), <i>Gem Identification Made Easy</i> , USA, Gemstone Press. 5. Pathak, KK, (2024). <i>Introductory Gemology</i> , BFC Publications. 7. V. Rajushila, (2012). <i>Healing Power Of Gems And Stones</i> , India- V&S Publishers 8. Kapoor, G.S. (2007), <i>Gems and Astrology: A guide to health happiness and prosperity</i> , India- Ranjan Publications 9. Anderson J.L., (2025) <i>Gemology Book of Colors: A Rainbow of Gemstones</i> , Ao Press 10. Parashar, P.R., (2024), <i>Ratna vigyan (Gemmology)</i> India-Chaukhamba Prakashan		

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁
CLO ₁	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₂	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₃	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0
CLO ₄	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	40
Entrepreneurship	30
Skill Enhancement	60
Communication Development	0
Indian Knowledge System	4
Environmental Awareness/SDGs	100
Current Issues and Social Awareness	60
Gender issues	0
Public policies	5
Any Other	20

Part A - Introduction			
Name of Programme	M.Sc. Geology		
Semester	III		
Name of the Course	Geo-Exploration		
Course Code	26L6.5-GGY--310		
Course Type	DEC-2		
Level of the course	500-599		
Pre-requisite for the course (if any)	Nil		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO1: Students will get introduced to basics of Prospecting and Exploration. CLO2: Students will learn about Geophysical methods of exploration. CLO3: Students will get to know about the Geochemical exploration techniques and well logging. CLO4: Students will get acknowledged to handle and compilation of exploration data.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		3 hours
Part B- Contents of the Course			
Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.			
Unit	Topics	CLO/s Attempt	Contact Hours
I	Basic terminology and definitions. Planning for Prospecting and Exploration Project. Principal steps in the mineral exploration. Role of Geologist in Prospecting to Mining. Geological concepts for exploration. Techniques in mineral exploration: Drilling, Core logging, blasting, Geological Sampling Methods	CLO 1	15
II	Geophysical methods of Exploration- fundamentals of Gravity, Magnetic, Electric and seismic Basics of GPR Survey, Remote Sensing & GIS as tool in Mineral Exploration.	CLO 2	15
III	Geochemical Explorations: Fundamentals, data acquisition and interpretation. Geobotanical exploration techniques. Geological mapping at different scales. Borehole logging- Introduction, formation evaluation, Resistivity, Gravity logs, SP and Sonic logging.	CLO 3	15
IV	Modeling of ore body-geological plans and sections, Mineral Exploration data handling, categorization of ore reserves, ore reserve estimation; National Mineral Policy and Legislations; few case studies of exploration projects.	CLO 4	15
Total Contact Hours			60
Suggested Evaluation Methods			

➤ Theory	30	➤ Theory:	70
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

SUGGESTED BOOKS:

1. Telford, W.M., Geldart, L.P. and Sheriff, R.E., (1990). *Applied Geophysics*, Cambridge University Press.
2. Kearey, P. Brooks, M. and Hill, I., (2002). *An Introduction to Geophysical Exploration*, Blackwell.
3. Charles J. Moon, Michael K.G. Whateley & Anthony M. Evans, (2006). *Introduction to Mineral Exploration* Second Edition Edited by Blackwell publishing.
4. Marjoribanks, R. (2010). *Geological Methods in Mineral Exploration and Mining*. Springer Science & Business Media.
5. Peele R., (1966). *Mining Engineers hand book*, Wiley–Blackwell.
6. Mckinstry, H.E. (1960). *Mining Geology*. Asia publishing house
7. Arogyaswami, R.P.N., (2017). *Courses in mining Geology*. Oxford IBH.
8. Clark, G.B. (1964). *Elements of mining*. John Wiley.
9. Evans, A.M., (1993). "Ore Geology and Industrial Minerals"
10. Krishnaswami, S. (1988). *Indian mineral resources*, New Delhi Oxford & IBH Publishing
11. Smirnov, V.I. (1976). *Geology of mineral deposits*. MIR Publishers.
12. Stanton, R.L., (1972). *Ore Petrology*, McGraw Hill Book Co., New York.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁
CLO ₁	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₂	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₃	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0
CLO ₄	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	40
Entrepreneurship	40
Skill Enhancement	60
Communication Development	0
Indian Knowledge System	4
Environmental Awareness/SDGs	100
Current Issues and Social Awareness	60
Gender issues	0
Public policies	5
Any Other	18

Part A - Introduction			
Name of the Programme	M.Sc. Geology		
Semester	III		
Name of the Course	Geology Lab-V		
Course Code	26L6.5-GGY--311		
Course Type	PC-5		
Level of the course	500-599		
Pre-requisite for the course (if any)	NIL		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO1: To be efficient in the practical knowledge about Economic Mineral deposits. CLO2: To enable the learners to identify the ore minerals. CLO3: To strengthen the understanding of aquifers, groundwater quality evaluation and groundwater exploration. CLO4: The learners will be able to interpret the hydrological maps and data.		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time	0	3 hours	
Part B- Contents of the Course			
Units	Content	CLO Attempted	Contact Hours
I	- Exercise based on physical identification of ores. - Exercise based on ore microscopy.	CLO1	30
II	- Exercise based on distribution of Indian economic minerals. - Exercised based on mineral economics.	CLO2	30
III	- Preparation and interpretation of water table contour map and depth of water table maps. - Determination of hydraulic conductivity in lab and field	CLO3	30
IV	- Chemical quality maps, hydrographic maps. - Analytical instruments and their uses - Interpretation of hydro-geochemical data.	CLO4	30
Total			120
Suggested Evaluation Methods			
Internal Assessment: 30		End Term Examination: 70	
• Class Participation:	5	Lab record	10
• Seminar/Demonstration/Viva-voce/Lab records etc.:	10	Viva-Voce	20
• Mid-Term Exam:	15	Write-up	40

Part C-Learning Resources

1. Prasad, U., (2010). Economic Mineral Deposits of India, New Delhi, CBS Publishers.
2. Charles J. Moon, Michael K.G. Whateley & Anthony M. Evans, (2006). Introduction to Mineral Exploration, UK: Blackwell.
3. Parmod, A.O., 2009, Handbook of minerals, Crystals, Rocks and Ores, New India Publishing Agency.
4. Bateman, A.M., Jensen, M.L., 2013, Economic mineral deposits, USA, John Wiley and Sons.
5. Gokhale and Rao, 1973, Ore Deposits of India, Delhi, Thomson Press.
6. Kumar R., 1985, Fundamentals of Historical Geology and Stratigraphy of India, New Delhi, Wiley Eastern Ltd.
7. Craig, J.R. and Vaughan, D.J. (1994) Ore Microscopy and Ore Petrography. USA: John Wiley & Sons
8. Guilbert, J.M. and Park Jr., C.F. (1986) The Geology of Ore deposits. Freeman & Co.
9. Laurence Robb. (2005) Introduction to ore forming processes. Wiley.
10. Sarkar, S.C. and Gupta, A. (2014) Crustal Evolution and Metallogeny in India. Cambridge Publications.
11. Davis, S.N. and De Weist, R.J.M. (1966) Hydrogeology, N.Y. John Wiley & Sons Inc.,
12. Karanth K.R. (1987) Groundwater: Assessment, Development and management, Tata McGrawHill Pub. Co. Ltd.
13. Todd, D. K. (2006) Groundwater hydrology, 2nd Ed., John Wiley & Sons, N.Y.
14. Ward, R.C. and Robinson, M., (2011) *Principle of Hydrology*, Mumbai: Tata McGraw Hill.
15. Chow, V.T., (1964). *Hand Book of applied Hydrology*, USA: McGraw Hill.
16. Heath, R.C. and Trainer, F.W., (1968). *Introduction to groundwater hydrology*, N.Y. John Wiley and Sons.
17. Davis, S.N., and Dewiest. R.J.M., 1966) *Hydrogeology*, N.Y.: John Wiley and Sons.
18. Toman, C.F., 1937). *Ground water*, USA: McGraw Hill.
19. Wister, C.P. & Brater, E.F., (1969) *Hydrology*, Tokyo: Yoppen Co. Ltd,
20. Dewiest, R.J.M., (1966) *Geohydrology*, NY: John Wiley and Sons.

Mapping of Course Learning Outcomes (CLOs) to Program

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁
CLO ₁	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₂	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₃	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0
CLO ₄	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	40
Entrepreneurship	50
Skill Enhancement	120
Communication Development	0
Indian Knowledge System	8
Environmental Awareness/SDGs	100
Current Issues and Social Awareness	60
Gender issues	0
Public policies	5
Any Other	16

Part A - Introduction			
Name of the Programme	M.Sc. Geology		
Semester	III		
Name of the Course	Geology Lab-VI		
Course Code	26L6.5-GGY--312		
Course Type	PC-6		
Level of the course	500-599		
Pre-requisite for the course (if any)	NIL		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	DEC-1 CLO1: To Identify Coal microconstituents and kerogen types in source rock. CLO2: To Gain the knowledge about technology and instrumentation in the field of Geosciences. CLO3: To Gain the knowledge about the concept and application of Isotope Geochemistry. CLO4: Practices to identifying and understanding the vertical and lateral distribution of facies and how they relate to sea-level fluctuations. DEC-2 CLO1: To gain the practical knowledge about the Engineering Geology and behaviour of rocks under stress. CLO2: Get to know about the statistical and application of computers knowledge in geology. CLO3: Identification and classification of gems. CLO4: Geological and geophysical techniques in geo-exploration.		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time	0	3 hours	
Part B- Contents of the Course			
Units	Content	CLO Attempted	Contact Hours
I	- Exercises on Coal microconstituents and kerogen types in source rock. - Exercises about technology and instrumentation in the field of Geosciences.	CLO1 & CLO2 of DEC-1	30
II	- Practical related to concepts and applications of Isotope Geochemistry. - Practices to identifying and understanding the vertical and lateral distribution of facies and how they relate to sea-level fluctuations.	CLO3 & CLO4 of DEC-1	30

III	- Experiments related to the practical aspects of the Engineering Geology and behaviour of rocks under stress. - Practical work related to statistical and applications of computer knowledge in geology.	CLO1 & CLO2 of DEC-2	30
IV	- Exercises on Identification and classification of gems. - Practical work related to Geological and geophysical techniques in geo-exploration.	CLO3 & CLO4 of DEC-2	30
Total			120
Suggested Evaluation Methods			
Internal Assessment: 30		End Term Examination: 70	
• Class Participation:	5	Lab record	10
• Seminar/Demonstration/Viva-voce/Lab records etc.:	10	Viva-Voce	20
• Mid-Term Exam:	15	write-up	40
Part C-Learning Resources			
- Richard, C. Selley, (2022). <i>Elements of Petroleum Geology</i>, London: Academic Press. - Chapman, R.E. (1983) <i>Petroleum Geology</i>. Elsevier, Amsterdam. - Hobson, G.D. (1977) <i>Developments in Petroleum Geology</i>, (Ed.), Applied Science Publishers, London. - Hutchinson, C. S., (1974). <i>Laboratory handbook of petrographic techniques</i>, USA, John Wiley. - Hugh R., (2021) <i>Using geochemical data</i>, Cambridge University Press. - Alam Singh, (1987). <i>Modern geotechnical engineering</i>, New Delhi, CBS Publishers. - Ramakrishna, TS (2006). Memoir 62: Geophysical Practice in Mineral Exploration and Mapping. Journal of Geological Society of India, 67(6), 801–801. - Telford, W.M., Geldart, L.P. and Sheriff, R.E., (1990), "Applied Geophysics", Cambridge University Press. - Catenuanu, O., (2014), Principles of Sequence Stratigraphy, Netherland: Elsevier, Amsterdam - Emery, D. and Myers, K.J., (1996) Sequence Stratigraphy, U.K. Blackwell, - Miall, A.D., (2009), The Geology of Stratigraphic Sequences, Berlin: Springer-Verlag, - Miall, A.D., (2010), Principles of Sedimentary Basin Analysis, 3rd edition, Berlin: Springer-Verlag, - Krynine and Judd, (2005), <i>Engineering Geology</i>, New Delhi, CBS publishers. - Lambe, T.W. and Whitman, R., (2005) <i>Soil mechanics</i>, Wiley India Pvt Ltd. - Tsytovich, N.A., (1976) <i>Soil mechanics</i>, Central Books Ltd. - Udall, S.L. and Dominy, F.E., (1987) <i>Design of small dams</i>, United States Govt. Printing Office. - Borradaile, G.J., (2003). Statistics of Earth science Data, Springer. - K., Han John, W., (2003). Elementary Numerical Analysis, Atkinson John Wiley & Sons. - Yang, W.Y., Cao, W., Chung, T.S., (2005). Applied Numerical Methods, John Wiley & Sons. - W.H., Teukolsky, S.A., Vetterling, W.T., Flannery, B.P., (1992). Numerical Recipes: The Art of Scientific Computing, Press, Cambridge University Press. - Davis, J.C., (2002). Statistics and Data Analysis in Geology, 3rd Ed., John Wiley & Sons. - Anton Skuratowicz and Julie Nash, (2005). Working with gemstones, MJSA/AJM Press. - Colin H. Winter and Hilary Taylor, (2003). A Students' Guide to Spectroscopy, OPL Press.			

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁	CLOs	PLO ₁
CLO ₁	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0	3.0	2.0
CLO ₂	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0	3.0	2.0
CLO ₃	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0	2.0	3.0
CLO ₄	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0	2.0	3.0

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	40
Entrepreneurship	50
Skill Enhancement	120
Communication Development	0
Indian Knowledge System	8
Environmental Awareness/SDGs	100
Current Issues and Social Awareness	60
Gender issues	0
Public policies	5
Any Other	16

Part A - Introduction				
Name of Programme	M.Sc. Geology			
Semester	III			
Name of the Course	GEOSCIENCE AND SOCIETY			
Course Code	26L5-OEC-GGY-313			
Course Type	OEC			
Level of the course	500-599			
Pre-requisite for the course (if any)	Nil			
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO1: Students will get introduced to geosciences and know about Earth's history; natural processes related etc. CLO2: Students will learn about natural resources and their significance, like water, mineral resources etc.			
Credits	Theory	Practical	Total	
	2	0	2	
Teaching Hours per week	2	0	2	
Internal Assessment Marks	15	0	15	
End Term Exam Marks	35	0	35	
Max. Marks	50	0	50	
Examination Time	2 hours		2 hours	
Part B- Contents of the Course				
Instructions for Paper- Setter: The paper setter shall prepare 5 questions selecting two questions from each of the two units with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question comprising 07 short answer type questions carrying one mark each (total 07 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt three questions: the compulsory question no. 1 and 1 question from the each of the two units.				
Unit	Topics		C.A.	C.H.
I	Introduction to Geo-science and its various branches, Earth and its place in the solar system. Origin and structure of Earth. Geological time scale. Origin and evolution of life through Earth history. Elementary idea of rocks, their types, rock cycle, minerals and gemstones. Elementary idea of various Earth processes, continental drift and plate tectonics. Orogenic and epeirogenic movements.		CLO1	15
II	Elementary idea of geological considerations in site evaluation of engineering, construction, mining and other geological works. Environmental changes through the Earth history. Significance of earth resources to mankind and society. Hydrological cycle and water budget of an Earth.		CLO2	15
Total Contact Hours			30	
Suggested Evaluation Methods				
Internal Assessment: 15			End Term Examination: 35	
• Class Participation:		5	Written Examination	
• Seminar/Demonstration/Viva-voce/Lab records etc.:		5		
• Mid-Term Exam:		5		
Part C-Learning Resources				
Recommended Books/e-resources/LMS:				

SUGGESTED BOOKS:

1. Press, F. and Siever, R., 1993. Understanding earth. New York: W.H. Freeman
2. Moore, J.S. and Wicander, R., 2007, *Physical Geology*, UK, Belmont, CA.
3. Hobbs, M.B.E., Means, W.D. and Williams, P.F., 1976, *An Outline of Structural Geology*, New Jersey, USA, John Wiley & Sons.
4. Pollard, D.D. and Fletcher, R.C., 2005, *Fundamentals of Structural Geology*, England, Cambridge University Press.
6. Billings, M.P., 1972, *Structural Geology*, Delhi, Prentice Hall India.
7. Klein, C., Cornelius, S.H., and Dana, J.D., 1848, *Danas Manual of Mineralogy*, New Jersey, USA, John Wiley & Sons.
8. Deer, W.A., Howie, R.A. and Zussman, J., 1966, *An Introduction to the Rock-Forming Minerals*, London, ELBS and Longman.
9. Read, H.H., 2012, *Rutley's Elements of Mineralogy*, Heidelberg, Germany, Springer.
10. Putnis, A., 1992, *Introduction to Mineral Sciences*, England, Cambridge University press.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁
CLO ₁	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₂	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₃	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0
CLO ₄	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	30
Entrepreneurship	30
Skill Enhancement	120
Communication Development	0
Indian Knowledge System	8
Environmental Awareness/SDGs	100
Current Issues and Social Awareness	120
Gender issues	0
Public policies	5
Any Other	16

Part A - Introduction			
Name of Programme	M.Sc. Geology		
Semester	IV		
Name of the Course	Geoinformatics		
Course Code	26L6.5-GGY-401		
Course Type	CC-11		
Level of the course	500-599		
Pre-requisite for the course (if any)	NIL		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO1: To be familiar with basics of remote sensing techniques. CLO2: Understanding of satellite remote sensing. CLO3: Know about the fundamentals of GIS. CLO4: Understand the application of Geoinformatics in Geoscience.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		3 hours
Part B- Contents of the Course			
Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.			
Unit	Topics	C.A.	C.H.
I	Introduction: Definition and Process, Advantages and limitations, a brief history of Remote Sensing with technological evolution, Electromagnetic Radiation and EM Spectrum, Interaction of radiation with atmosphere and objects with special emphasis on Atmospheric windows. Type of Platform and Sensors. Aerial photography: Types of aerial photographs, Photogrammetry, fundamentals of Stereoscopic studies;	CLO 1	15
II	Satellite Remote Sensing: concept of sensor's resolutions, Indian Space programme. Land Observation Satellites/Sensors, Basics of Microwave Remote Sensing and its scope for Geological applications. Image Quality: Factor effected the Quality of image, Fundamentals of digital image processing classification; Principles of image interpretation and Analysis;	CLO 2	15
III	GIS: Basic concept and definitions, functions of GIS; Components of GIS: Hardware, software and their specifications for GIS. GIS data types. Raster and vector data models. Errors in GIS data- their detection and optimization; Concept of thematic layers and topology. Digital terrain model and their applications. Global positioning system and Its applications.	CLO 3	15
IV	Applications of Remote Sensing and GIS technology: Photointerpretation to geology: Image characteristics of geological structures and various rock type, landforms and lineaments; Remote Sensing Applications in Earth Resource Management: natural hazards and disaster mitigation, Mineral Exploration and environmental monitoring. GIS as multidisciplinary tools and their applications in Earth Sciences.	CLO 4	15
Total Contact Hours		60	

Suggested Evaluation Methods		
Internal Assessment: 30		End Term Examination: 70
• Class Participation:	5	Written Examination- 70 Marks
• Seminar/presentation/assignment/quiz/class test etc.:	10	
• Mid-Term Exam:	15	
Part C-Learning Resources		
1. Gupta, R.P., (1991). Remote sensing Geology Springer – Verlag		
2. Pandey, S.N. (1987). Principles and applications of photogeology Tata – McGraw Hill.		
3. Siegal B.S. and A.R. (1981). Remote sensing in Geology John Wiley & sons,		
4. Miller V.C. and Miller C.F., (1971). Photogeology. MCGraw Hill,		
5. Lillesand T.M. and Kieffer, R.W. (2011), Remote sensing and image interpretation John Wiley & Sons.		
6. Sabbins F.F., (1997). Remote principles and interpretations. W.H. Freeman Company.		
7. Rao. D.P., (1999). Remote sensing for earth resources. AEG publications, Hyderabad.		
8. Colwell, R. (1983). Manual of Remote sensing. American Society of Photogrammetry.		
9. P.J., Currian., (1985). Principles of Remote Sensing. ELBS, London.		
10. Advances in Geophysics Vol. 1 and 13 (Academic Press) H.E. Landsberg.		
11. Hand book/ brochures issued by Geological Survey of India (Airborne Mineral Survey and Exploration Wing), Atomic energy commission (Atomic Minerals Division) and National Geophysical Research Institute.		

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁
CLO ₁	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₂	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₃	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0
CLO ₄	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	40
Entrepreneurship	50
Skill Enhancement	120
Communication Development	0
Indian Knowledge System	8
Environmental Awareness/SDGs	60
Current Issues and Social Awareness	120
Gender issues	0
Public policies	5
Any Other	20

Part A - Introduction			
Name of Programme	M.Sc. Geology		
Semester	IV		
Name of the Course	Palaeoecology, Palaeoclimatology and Palaeogeography		
Course Code	26L6.5-GGY-402		
Course Type	CC-12		
Level of the course	500-599		
Pre-requisite for the course (if any)	Nil		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Know about the basics of Palaeoecology. CLO 2: Gain knowledge about the fundamentals of Palaeoclimate. CLO 3: Know about Palaeogeography. CLO 4: Gain knowledge regarding the linkage between palaeoecology, palaeoclimatology and palaeogeography.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		
Part B- Contents of the Course			
Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.			
Unit	Topics	CLO/s Attempt	Contact Hours
I	Concepts of palaeoecology; application of community analysis in palaeoenvironmental reconstruction. Temporal patterns of communities—evolutionary changes in fauna and flora in response to environmental changes. Significant events in geological time.	CLO 1	15
II	Concept of paleoclimate and its applications. Major palaeoclimatic events during the Quaternary period, with special emphasis on the Indian subcontinent. Milankovitch cycles and climatic variability.	CLO 2	15
III	Archives of climate change and palaeoclimate; interpretation of proxy records for palaeoclimate reconstruction. Applications of elemental and isotope geochemistry in palaeoclimatology. Interplay of tectonics, weathering, and climate over geological time.	CLO 3	15
IV	Palaeogeography: palaeogeographic reconstructions, palaeogeography of India during Gondwana, Paleogene and Neogene duration. Gondwana tectonics and pre-Himalayan palaeogeography. A History of Earth & Supercontinents	CLO 4	15
Total Contact Hours			60
Suggested Evaluation Methods			

➤ Theory	30	➤ Theory:	70
•Class Participation:	5	Written Examination-70 marks	
•Seminar/presentation/assignment/quiz/class test etc.:	10		
•Mid-Term Exam:	15		
Part C-Learning Resources			
Recommended Books/e-resources/LMS:			
1. Flessa, K. W. (Ed.). (2009). <i>Foundations of Paleoecology: Classic Papers with Commentaries</i> . University of Chicago Press.			
2. Khare, N. (Ed.). (2021). <i>Quaternary Climate Change over the Indian Subcontinent</i> . CRC Press.			
3. Bradley, R. S. (2015). <i>Paleoclimatology: Reconstructing Climates of the Quaternary</i> , Academic Press.			
4. Agrawal, D. P., Gupta, S. K., & Sharma, P. (Eds.). (1988). <i>Palaeoclimatic and Palaeoenvironmental Changes in Asia</i> . Indian National Science Academy.			
5. Emiliani, C. (1992). <i>Planet Earth: Cosmology, Geology, and the Evolution of Life and Environment</i> . Cambridge University Press.			
6. Smol, J. P., Birks, H. J. B., & Last, W. M. (Eds.). (2001). <i>Tracking Environmental Change Using Lake Sediments: Volume 1: Basin Analysis, Coring, and Chronological Techniques</i> . Kluwer Academic Publishers.			
7. Walton, W.C., (1970). <i>Groundwater Resource</i> , McGraw Hill.			
8. Raghunath, H.M., (1983) <i>Ground water</i> , Wiley Eastern Ltd.			
9. Joya, P. and Reddy Remi, <i>Hydrology</i> , Laxmi Publications, Delhi.			
10. Robinson, E.S., (1983). <i>Basic Exploration Geophysics</i> , Wiley.			

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁
CLO ₁	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₂	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₃	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0
CLO ₄	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	20
Entrepreneurship	30
Skill Enhancement	60
Communication Development	0
Indian Knowledge System	8
Environmental Awareness/SDGs	100
Current Issues and Social Awareness	80
Gender issues	0
Public policies	5
Any Other	16

Part A - Introduction			
Name of Programme	M.Sc. Geology		
Semester	IV		
Name of the Course	Applied Geochemistry		
Course Code	26L6.5-GGY--403		
Course Type	DEC-3		
Level of the course	500-599		
Pre-requisite for the course (if any)	NIL		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO1: Understand the cosmic abundance of elements. CLO2: Understand the substitution and diffusion processes in earth system science. CLO3: Understand the process of decay of radioactive elements and applications of radiometric dating. CLO4: Understand the stable isotope geochemistry and its application.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		3 hours
Part B- Contents of the Course			
Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.			
Unit	Topics	C.A.	C.H.
I	Cosmic abundance, meteorites-types and composition, bulk composition of the Earth, Goldschmidt's classification of elements, Chemical composition and characteristics of atmosphere, lithosphere and hydrosphere.	CLO 1	15
II	Geochemical differentiation of the earth; geochemical cycles.; Ionic substitution, fractionation of elements in minerals/rocks: Partition coefficient and bulk partition coefficient; application of trace elements in petrogenesis;	CLO 2	15
III	Radioactive decay schemes and their application to geochronology and petrogenesis. Stable isotopes and their application to earth system processes; Principle and application of K-Ar, Rb-Sr, U-Pb, Sm Nd dating systems; Monazite chemical dating	CLO 3	15
IV	Geochemical composition of river water, groundwater and seawater, residence time, and water-rock interaction; Principles of environmental geochemistry (pH, Salinity, TDS, BOD, COD). Stable isotopes geochemistry: Carbon, Oxygen and Sulphur, Applications of Stable isotopes in geology	CLO 4	15
Total Contact Hours		60	

Suggested Evaluation Methods		
Internal Assessment: 30		End Term Examination: 70
● Class Participation:	5	Written Examination
● Seminar/presentation/assignment/quiz/class test etc.:	10	
● Mid-Term Exam:	15	
Part C-Learning Resources		
Recommended Books/e-resources/LMS:		
1. Mason, B. and Moore, C.B., 1991, <i>Introduction to Geochemistry</i> , Wiley Eastern.		
2. Krauskopf, K.B., 1967, <i>Introduction to Geochemistry</i> , McGraw Hill.		
3. Faure, G., 1986, <i>Principles of Isotope Geology</i> , John Wiley & Sons.		
4. Hoefs, J., 1980, <i>Stable Isotope Geochemistry</i> , Springer-Verlag.		
5. Wedepohl, K. H. 1971; <i>Geochemistry</i> . USA: Holt, Rinehart & Winston.		
6. Brownlow A.H. (1996) <i>Geeochemistry, Second Edition</i> , Prentice Hall, New Jersey.		
7. Henderson, P. 1982 <i>Inorganic Geochemistry</i> . Oxford. Pergamon Press.		
8. Nordstrom, D.K. and Munoz, J.L. (1986) <i>Geochemical Thermodynamics</i> . Blackwell Scientific Publications, New York.		
9. Govett, G.J.S., (1983). <i>Hand book of Exploration Geochemistry</i> , Elsevier.		
10. Faure, G. and Mensing, T. M., (2005) <i>Isotopes: Principles and Applications</i> , John Wiley & Sons,		
11. Dickin, A. P., (1995) <i>Radiogenic Isotope Geology</i> , Cambridge University Press.		
12. White, M. William, (2014) <i>Isotope Geochemistry</i> , Wiley – Blackwell.		

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁
CLO ₁	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₂	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₃	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0
CLO ₄	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	60
Entrepreneurship	60
Skill Enhancement	120
Communication Development	0
Indian Knowledge System	8
Environmental Awareness/SDGs	100
Current Issues and Social Awareness	60
Gender issues	0
Public policies	5
Any Other	16

Part A - Introduction			
Name of Programme	M.Sc. Geology		
Semester	IV		
Name of the Course	Oceanography and Marine Geology		
Course Code	26L6.0-GGY-404		
Course Type	DEC-3		
Level of the course	500-599		
Pre-requisite for the course (if any)	NIL		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Describe the fundamentals of oceanography, including ocean floor morphology, tectonic features, and the formation of oceanic crust and hydrothermal systems. CLO 2: Explain the principles and outcomes of scientific ocean drilling and major oceanic circulation Systems, including the Coriolis effect, Ekman transport, and thermohaline circulation. CLO 3: Analyze the distribution and types of oceanic sediments, their depositional controls, and the Use of marine proxies in reconstructing past climate variability. CLO 4: Apply micropaleontological and geochemical methods for interpreting marine stratigraphy, Identifying hiatuses, and correlating marine records, particularly in the Indian Ocean context.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		3 hours
Part B-Contents of the Course			
Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course-learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.			
Unit	Topics	CLO Attempted	Contact Hours
I	Introduction of Oceanography and its applications. Morphologic and tectonic domains of the ocean floor. Structure, composition and mechanism of the formation of oceanic crust. Hydrothermal vents. Ocean margins and their significance. coral reefs: their distribution and origin.	CLO 1	15
II	Scientific Ocean Drilling - Major accomplishments. Ocean Circulation, Coriolis effect and Ekman spiral, convergence, divergence and upwelling, El Nino and Indian Ocean Dipole. Thermohaline circulation. Formation of Bottom waters; major	CLO 2	15

	water masses of the world’s oceans		
III	Oceanic sediments: Factors controlling the deposition and distribution of oceanic sediments; geochronology and types of oceanic sediments. Reconstruction of monsoon variability by using marine proxy records. Opening and closing of ocean gateways and their effect on circulation and climate during the Cenozoic.	CLO 3	15
IV	Historical development of marine Geology. Sea level changes and causes. Mineral resources of the ocean and their economic potential. Marine pollution. Quaternary glacial and interglacial record, marine isotope stages. Marine stratigraphy, correlation and chronology; Deep sea hiatuses and their causes with special emphasis on Indian ocean.	CLO 4	15
Total Contact Hours		60	
Suggested Evaluation Methods			
Internal Assessment: 30		End Term Examination: 70	
•Class Participation:	5	Written Examination-70 Marks	
•Seminar/presentation/assignment/quiz/class test etc.:	10		
•Mid-Term Exam:	15		
Part C-Learning Resources			
Recommended Books/e-resources/LMS:			
1. Trujillo, A.P. & Thurman, H.V. Pearson 2017, Essentials of Oceanography (12th Edition)			
2. Garrison, T. & Ellis, R.Cengage Learning 2018 Oceanography: An Invitation to Marine Science (9th Edition)			
3. Pinet, P.R. Jones & Bartlett Learning 2019. Invitation to Oceanography (8th Edition)			
4. Talley, L.D. et al. Elsevier 2017 Descriptive Physical Oceanography: An Introduction (6 th Edition)			
5. R.H. Texas A & Introduction to Physical Oceanography Stewart, M University (Open Access) 2020			
6. Siedler, G. et al. (2013) Ocean Circulation and Climate: A 21st Century Perspective (2nd Edition) Academic Press			
7. Bradley, R.S. (2015) Paleoclimatology: Reconstructing Climates of the Quaternary (3rd Edition) Academic Press			
8. Berger, A. et al. (2018) Climate Change and Human Impact on the Landscape, Springer			
9. Rahmstorf, S. & (2018) Our Threatened Oceans: Science and Solutions Schellnhuber, H.J. Haus Publishing			
10. Chester, R. & Jickells, T. (2020) Marine Geochemistry (4th Edition) Wiley-Blackwell			

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁
CLO ₁	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₂	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₃	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0
CLO ₄	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	40
Entrepreneurship	50
Skill Enhancement	120
Communication Development	0
Indian Knowledge System	8
Environmental Awareness/SDGs	120
Current Issues and Social Awareness	60
Gender issues	0
Public policies	5
Any Other	20

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Geology		
Semester	IV		
Name of the Course	Geoheritage, Geoparks and Geotourism		
Course Code	26L6.5-GGY--405		
Course Type	DEC-3		
Level of the course	500-599		
Pre-requisite for the course (if any)	NIL		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 305.1: Know about fundamentals of isotope geochemistry. CLO 305.2: Acknowledge the radiogenic isotope systems and geochronology CLO 305.3: Understand the principle and application of stable isotope geochemistry. CLO 305.4: Understand the application of isotope geochemistry in earth and planetary sciences.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		3 hours
Part B- Contents of the Course			
Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.			
Unit	Topics	CLO Attempted	Contact Hours
I	Introduction to Geo heritage and Geo tourism: Definition, Concept and evolution; Relationship between Geo heritage and Geo tourism; Significance of Geo heritage and Geo tourism. Geodiversity and Geo conservation: Geodiversity Values – Intrinsic, cultural, aesthetic, economic, functional, and scientific; Threats to Geodiversity; Geo conservation principles to protect Geo heritage.	CLO 1	15
II	Potential of Geo heritage and Geo tourism: Case Study of Geoparks, Mountain landscape, Geothermal sites and Volcanic landscape.	CLO 2	15
III	Geoheritage, Geotourism and Sustainable Development: Role of Geoheritage and Geotourism for sustainable social, economic and cultural development of a region. Application of GIS in Geotourism.	CLO 3	15

IV	Inventory of World Geo heritage Sites: Identification and selection criteria with special reference to UNESCO. Geoheritage and Protection Laws: Role of local, state and national governments; Current status of Geoheritage protection in the country; Global geoheritage and protection laws.	CLO 4	15
Total Contact Hours		60	
Suggested Evaluation Methods			
Internal Assessment: 30		End Term Examination: 70	
• Class Participation:	5	Written Examination- 70marks	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		
Part C-Learning Resources			
Recommended Books/e-resources/LMS:			
1. C. Anze, L. Yunting and C.Y. Ng. Young (2015). The Principles of Geotourism, Science Press, Beijing			
2. C.V. Burek and C.D. Prosser (2008). The History of Geoconservation, The Geological Society, London, Special Publications, 300			
3. D.R. Reddy (2020). A Monograph on Potential Geoparks of India, INTACH, New Delhi			
4. 36th IGC (2016). Geotourism Hotspots of Indian Subcontinent, GSI, New Delhi			
5. C. Sharples (2002). Concepts and Principles of Geoconservation, Tasmanian Parks and Wildlife Service, Australia			
6. M. Gray (2004). Geodiversity – Valuing and Conserving Abiotic Nature, John Wiley & Sons Ltd., USA			
7. R.K. Dowling and D. Newsome (2006). Geotourism – Sustainability, Impacts and Management, Elsevier Butterworth-Heinemann, Oxford			
8. R. Crofts, J.E. Gordon, J. Brilha, M. Gray, J. Gunn, J. Larwood, V.L. Santucci, D. Tormey and G.L. Worboys (2020). Guidelines for Geoconservation in Protected and Conserved Areas, Best Practice Protected Area Guidelines, Series No. 31, IUCN, Switzerland			

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁
CLO ₁	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₂	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₃	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0
CLO ₄	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	40
Entrepreneurship	50
Skill Enhancement	80
Communication Development	0
Indian Knowledge System	8
Environmental Awareness/SDGs	120
Current Issues and Social Awareness	60
Gender issues	0
Public policies	5
Any Other	20

Part A - Introduction			
Name of Programme	M.Sc. Geology		
Semester	IV		
Name of the Course	Environmental Geology		
Course Code	26L6.5-GGY-406		
Course Type	DEC-3		
Level of the course	500-599		
Pre-requisite for the course (if any)	NIL		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Understand ecology and their inter-relationship With mankind. CLO 2: Learn about water quality and waste management. CLO 3: Get knowledge regarding Natural resources and their conservation. CLO 4: Comprehend environmental impact assessment and knowledge of environmental laws.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		
Part B-Contents of the Course			
<u>Instructions for Paper- Setter:</u> The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.			
Unit	Topics	C.A.	C.H.
I	Components of environment, ecology and ecosystem. Interactions between atmosphere, hydrosphere, lithosphere, biosphere and man. Principles of environmental geology and ethics of conservation. Atmosphere: Increasing trend of CO ₂ and other greenhouse gases. Fossil fuel burning, ozone layer depletion and global warming. Smog pollution, acid rains, causes and remedies. Other causes of pollution.	CLO 1	15
II	Hydrologic cycle and Earth's water balance. Pollution of surface and subsurface water. Water quality criteria for domestic and industrial use. Water quality degradation due to use of fertilizers, pesticides and geogenic causes. Hydro-geologic considerations for liquid waste disposal. Hydrologic implications of solid waste disposals. Waste (solid, liquid, gases) management and control.	CLO 2	15
III	Natural resources of Earth and their depletion. Land degradation due to natural hazards. Land conservation and land use planning. Watershed management, impact of irrigation - water logging and soil degradation. Energy minerals and their conservation, non-conventional sources of energy, nuclear waste and its disposal.	CLO 3	15

IV	Types of microorganisms. Role of sulfur, nitrogen and iron bacteria in the environment. Biogeochemistry of iron, manganese and sulfur. Marine pollution- causes and controls. Environmental impact assessment – impact of mining on environment, environmental health and environmental law in India.	CLO 4	15
Total Contact Hours		60	
Suggested Evaluation Methods			
Internal Assessment: 30		End Term Examination: 70	
• Class Participation:	5	Written Examination- 70marks	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		
Part C-Learning Resources			
Recommended Books/e-resources/LMS			
1. Lindgren, L., (1986). <i>Environmental geology</i> , Prentice Hall.			
2. Keller, E. A., (2000). <i>Environmental geology</i> , Pearson.			
3. Angeletti, G., (1985). <i>Organic micro-pollutants in the aquatic environment</i> , Springer Science Business Media.			
4. Strahler, A. N. and Strahler, A. H., (1973). <i>Environmental Geoscience: Interaction between natural systems and man</i> , John Wiley and Sons Inc.			
5. Tripathi, A. K. and Panday, S. N., (2008). <i>Water pollution</i> , CBS publishers.			
6. Valdiya K. S. (2013). <i>Environmental Geology: Ecology, Resource and Hazard Management</i> , McGraw Hill Education.			
7. Bennett, M. R. (2016), <i>Environmental Geology: Geology and the Human Environment</i> , Wiley India Pvt. Ltd.			
8. Alan E Kehew, (2022). <i>Geology for Engineers and Environmental Scientists</i> , Pearson.			
9. Bell, F.G., (2003). <i>Geological Hazards</i> , Taylor & Francis			
10. Patwardhan, A.M., (2010). <i>The Dynamic Earth System</i> , PHI Learning.			

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁
CLO ₁	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₂	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₃	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0
CLO ₄	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	40
Entrepreneurship	50
Skill Enhancement	40
Communication Development	0
Indian Knowledge System	8
Environmental Awareness/SDGs	120
Current Issues and Social Awareness	60
Gender issues	0
Public policies	5
Any Other	60

Part A - Introduction			
Name of Programme	M.Sc. Geology		
Semester	IV		
Name of the Course	Mining Geology		
Course Code	26L6.5-GGY-407		
Course Type	DEC-4		
Level of the course	500-599		
Pre-requisite for the course (if any)	NIL		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Understand the prospecting, exploration and mining. CLO 2: To understand the function of mining industry and mining operations. CLO 3: Provide knowledge regarding various methods of mining. CLO 4: Learn about mine economic appraisals & resource management.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		3 hours
Part B- Contents of the Course			
Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course-learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.			
Unit	Topics	C.A.	C.H.
I	Basic terminology and definitions. Planning for Prospecting and Exploration Project. Principal steps in the exploration and exploitation of mineral deposits, Geological Exploration concepts. Techniques in mineral exploration: Drilling, Core logging, Modeling of ore body-geological plans and sections.	CLO 1	15
II	Introduction to Mining: Principles of Mining Industry, Mining Operations: Blasting and types of Explosive, Mine support and Mine safety measures, Environmental issues related to mining.	CLO 2	15
III	Methods of Mining: controlling factors for selection of mining method, Classification of Mining methods, Surface Mining: Mechanical and Aqueous Extraction; Subsurface Mining methods, Mine Mapping- Mapping in Open Cuts & Underground Openings, underground mine mapping.	CLO 3	15
IV	Mine Economic appraisals: financial management, Resources management, Elements of Mineral Dressing & mineral beneficiation, Role of geologists in mine operations.	CLO 4	15
Total Contact Hours			60
Suggested Evaluation Methods			
Internal Assessment: 30		End Term Examination: 70	
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		

•Mid-Term Exam:

15

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Craig, J.R. and Vaughan, D.J. (1994) Ore Microscopy and Ore Petrography. USA: John Wiley & Sons
2. Guilbert, J.M. and Park Jr., C.F. (1986) The Geology of Ore deposits. Freeman & Co.
3. Laurence Robb. (2005) Introduction to ore forming processes. Wiley.
4. Sarkar, S.C. and Gupta, A. (2014) Crustal Evolution and Metallogeny in India. Cambridge Publications.
5. Marjoribanks, R. (2010). Geological Methods in Mineral Exploration and Mining. Springer Science & Business Media.
6. Peele R., (1966). Mining Engineers hand book, Wiley–Blackwell.
7. Mckinstry, H.E. (1960). Mining Geology. Asia publishing house
8. Arogyaswami, R.P.N., (2017). Courses in mining Geology. Oxford IBH.
9. Clark, G.B. (1964). Elements of mining. John Wiley.
10. Evans, A.M., (1993). "Ore Geology and Industrial Minerals"
11. Krishnaswami, S. (1988). Indian mineral resources, New Delhi Oxford & IBH Publishing.
12. Smirnov, V.I. (1976). Geology of mineral deposits. MIR Publishers.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁
CLO ₁	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₂	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₃	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0
CLO ₄	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	40
Entrepreneurship	40
Skill Enhancement	40
Communication Development	0
Indian Knowledge System	8
Environmental Awareness/SDGs	120
Current Issues and Social Awareness	60
Gender issues	0
Public policies	5
Any Other	20

Part A - Introduction				
Name of Programme	M.Sc. Geology			
Semester	IV			
Name of the Course	Disaster Management			
Course Code	26L6.5-GGY-408			
Course Type	DEC-4			
Level of the course	500-599			
Pre-requisite for the course (if any)	Nil			
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO1: Know about the key concepts of disaster management. CLO2: Gain knowledge about various types of disasters. CLO3: Learners will come to know about the consequences of different disasters. CLO4: Will understand the relation between climate change and disasters.			
Credits	Theory	Practical	Total	
	4	0	4	
Teaching Hours per week	4	0	4	
Internal Assessment Marks	30	0	30	
End Term Exam Marks	70	0	70	
Max. Marks	100	0	100	
Examination Time	3 hours			
Part B- Contents of the Course				
Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.				
Unit	Topics		C.A.	C.H.
I	Understanding of key concepts in Disasters Management: Hazards, Disasters, Vulnerability, Resilience, Disaster Management, Disaster Cycle, risk, prevention, mitigation, relief and response, recovery and rehabilitation etc – Brief history of disaster management in India and world- The emerging field of disaster management- Role of Geoscience and applied disciplines.		CLO 1	15
II	Different typologies and classification of disasters, cataclysmic – slow-onset, natural- manmade etc- Critique of different classifications, what magnitude constitutes a “disaster” for the government. Effects of hazards: Primary, secondary and tertiary.		CLO 2	15
III	Consequences and impact of disasters; Flood, cyclones, tsunamis, earthquakes, landslides, volcanic eruption, desertification, drought, salinity ingress – Overview through case studies		CLO 3	15
IV	Climate change, environmental stress, Nature of challenges in disaster management for people and environment, Lessons (overview of the field of study and nature of functions required of different professionals learnt, Role of disaster management in contemporary times).		CLO 4	15
Total Contact Hours			60	
Suggested Evaluation Methods				
Internal Assessment: 30			End Term Examination: 70	
• Class Participation:		5	Written Examination- 70marks	
• Seminar/presentation/assignment/quiz/class test etc.:		10		
• Mid-Term Exam:		15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Ahmad, A. (2010): Disaster Management: Through the New Millennium, Anmol Publications, New Delhi.29
2. Bryant Edwards (2005). Natural Hazards, Cambridge University Press, U.K.
3. Bureau of Indian Standards (2002). Indian Standards: Criteria for Earthquake Resistant Design of Structures, Part I, Fifth Revision.
4. Burton, I., Kates, R.W. and White, G.F. (1993). Environment as Hazard, 2nd edition, Guilford Press, New York.
5. Central Water Commission (1989). Manual of Flood Forecasting, New Delhi.
6. Goel, S.L., (2006): Encyclopedia of Disaster Management, Deep and Deep Publications, New Delhi.
7. Gosh, G.K., (2012): Disaster Management, A.P.H. Publishing Corporation, New Delhi.
8. Government of India, (2004): Disaster Management in India -A Status Report.
9. Government of India (1997). Vulnerability Atlas of India (New Delhi: Building Materials and Technology Promotion Council, Ministry of Housing & Urban Poverty Alleviation).
11. Government of India, (2005): Disaster Management in India, <http://www.unisdr.org/2005/mdgs-drr/national-reports/Indiareport.pdf>.
12. Gupta, H.K., (2003): Disaster Management, Universities Press (India) Private Limited, Hyderabad.
13. Kapur, A (2005). Disasters in India: Studies of Grim Reality, Rawat Publications, Jaipur.
14. Kapur, A. (2010). Vulnerable India: A Geographical Study of Disasters, Sage Publications, New Delhi.
15. NDMA (2009): National policy on Disaster Management, http://nidm.gov.in/PDF/policies/ndm_policy2009.pdf.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁
CLO ₁	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₂	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₃	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0
CLO ₄	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	40
Entrepreneurship	40
Skill Enhancement	60
Communication Development	0
Indian Knowledge System	8
Environmental Awareness/SDGs	120
Current Issues and Social Awareness	80
Gender issues	0
Public policies	5
Any Other	20

Part A - Introduction			
Name of Programme	M.Sc. Geology		
Semester	IV		
Name of the Course	Pleistocene Geology		
Course Code	26L6.5-GGY--409		
Course Type	DEC-4		
Level of the course	500-599		
Pre-requisite for the course (if any)	Nil		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: To understand the significance of the Quaternary period and identify major Quaternary basins, particularly in the context of Indian geology. CLO 2: Understand the interdisciplinary relationship between geology and archaeology. CLO 3: To understand the role and scope of paleontological and archaeo-zoological research in reconstructing past environments, with special reference to Indian contexts. CLO 4: Analyze environmental and climatic changes during the Pleistocene and Holocene epochs, and assess their impact on geomorphic systems such as rivers, glaciers, and coastlines.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		3 hours
Part B-Contents of the Course			
Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.			
Unit	Topics	C.A.	C.H.
I	Importance of the Quaternary Period and Location of Quaternary Basins. Relationship between Archaeology and Geology. Archaeology – Definition, aims, scope, and evolution. Scope of Paleontology and Archaeo-zoological Studies, with special reference to India.	CLO 1	15
II	Quaternary Period: Pleistocene and Holocene – Environmental and climatic changes. Responses of geomorphic systems to climate, sea level, and tectonics on variable timescales during the Quaternary. Pleistocene flora and fauna, and significant fossil records.	CLO 2	15
III	Pleistocene Geochronology. Quaternary Stratigraphy of India – Continental records (fluvial, glacial, aeolian, palaeosols, speleothems, and duricrusts); marine records; and continental–marine correlation of the Quaternary record. Neotectonics.	CLO 3	15
IV	Evolution of Humans and Stone Age Cultures. Plant and animal life in relation to glacial and interglacial cycles during the Quaternary. The Indo-Gangetic Plain and Himalayan glaciations. Climate Change and Global	CLO 4	15

	Warming.		
Total Contact Hours		60	
Suggested Evaluation Methods			
Internal Assessment: 30		End Term Examination: 70	
• Class Participation:	5	Written Examination- 70marks	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		
Part C-Learning Resources			
Recommended Books/e-resources/LMS:			
1. D. Q. Bowen, 1978: Quaternary Geology, Pergamon			
2. R. F. Flint, 1971: Glacial and Quaternary geology			
3. A.G. Dawson, 1992, Ice age earth. Late quaternary geology and climate. Routledge, London			
4. Griffith Taylo, 2008: History of Geomorphology and Quaternary Geology.			
5. "Glacial Geology and the Pleistocene Epoch" by Richard Foster Flint.			
6. "The Pleistocene: Geography, Geology, and Fauna" edited by Gaetan Huard and Jeannine Gareau.			
7. The Canadian Ice Age: Being Notes On The Pleistocene Geology Of Canada by George Mercer.			
8. "Vanished Giants: The Lost World of the Ice Age" by Anthony J. Stuart.			

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁
CLO ₁	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₂	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₃	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0
CLO ₄	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	40
Entrepreneurship	40
Skill Enhancement	40
Communication Development	0
Indian Knowledge System	8
Environmental Awareness/SDGs	100
Current Issues and Social Awareness	60
Gender issues	0
Public policies	5
Any Other	20

Part A - Introduction			
Name of Programme	M.Sc. Geology		
Semester	IV		
Name of the Course	Field Geology		
Course Code	26L6.5-GGY--410		
Course Type	DEC-4		
Level of the course	500-599		
Pre-requisite for the course (if any)	Nil		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO1: To understand the field mapping methods. CLO2: To understand how to operate the field instruments and collect the samples. CLO3: Gain the knowledge geological structures. CLO4: Students will get knowledge to compile the field data and report writing.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		3 hours
Part B- Contents of the Course			
<u>Instructions for Paper- Setter:</u>			
The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.			
Unit	Topics	C.A.	C.H.
I	Role of Field geology and field geologist- Field methods and Types of investigations- Purpose of Geological mapping- Field maps- Scale of maps. Topographic expressions and relief-Investigation of out crops-inlier and outlier-Soils and vegetation.	CLO 1	15
II	Previous literature and importance - Selection of camp site- Climate and region: Arid, Semiarid and Mountain. Organization of field camp- Requirements and precautions-Equipment and supplies Basic, Additional, Supplementary, Special and Optional. Components and uses of Clinometer and Brunton Compass.	CLO 2	15
III	Geological Mapping-General considerations- Depiction of relief- Latitude and longitude-Map Grids Investigation of surface features, cuttings, quarries and mines. Measurement of strike and dip Bearing and reading directions. Outline of field work with igneous, sedimentary and metamorphic rocks.	CLO 3	15
IV	Samples and sampling methods- Trimming of hand specimens, fossil specimens, mineral specimens. Numbering, labeling, packing and storage of samples. Symbols for geologic maps and lithology. Marking on maps- Mounting and folding of field maps. Field photographs. Applications of computer in preparation of geological map and writing report.	CLO 4	15
Total Contact Hours		60	

Suggested Evaluation Methods		
Internal Assessment: 30		End Term Examination: 70
• Class Participation:	5	Written Examination- 70 Marks
• Seminar/presentation/assignment/quiz/class test etc.:	10	
• Mid-Term Exam:	15	
Part C-Learning Resources		
Recommended Books/e-resources/LMS:		
1. F.H.Lahee (2002) Field geology, 6 th ed. McGraw Hill, Publishers.		
2. C.L.Dake and C.S.Brown. Interpretation of topographic maps,		
3. J.W.Low (1957) Geological field methods, Harper & Brothers publishers.		
4. R.R. Compton (1962) Field Geology, Wiley Publishers.		
5. S.M.Mathur (2015) Guide to Field Geology, PHI Learning Private Limited, Delhi.		
6. J.D. Foresten. Principles of field and mining geology, Wiley Publishers		
7. G.W.Himus and G.S.Sweeting. Elements of field geology,		
8. G.W.Chiplonker (1960) Geological Maps, Dastane Bros., Pune.		
9. W.B.Upton (1986) Landforms and topographic maps, John Wiley Publishers.		
10. N.W.Gokhale (1987) Manual of geological maps, CBS Publishers and Distributors.		

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁
CLO ₁	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₂	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₃	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0
CLO ₄	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	40
Entrepreneurship	40
Skill Enhancement	120
Communication Development	0
Indian Knowledge System	8
Environmental Awareness/SDGs	100
Current Issues and Social Awareness	60
Gender issues	0
Public policies	5
Any Other	20

Part A - Introduction			
Name of Programme	M.Sc. Geology		
Semester	IV		
Name of the Course	Entrepreneurship Approaches in Geology		
Course Code	26L6.5-GGY--413		
Course Type	EEC		
Level of the course	500-599		
Pre-requisite for the course (if any)	Nil		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO1: To understand basics of Earth resources and Geological data analysis. CLO2: To gain the knowledge of fundamentals of entrepreneurship and planning for business.		
Credits	Theory	Practical	Total
	2	0	2
Teaching Hours per week	2	0	2
Internal Assessment Marks	15	0	15
End Term Exam Marks	35	0	35
Max. Marks	50	0	50
Examination Time	2 hours		2 hours
Part B- Contents of the Course			
Instructions for Paper- Setter: The paper setter shall prepare 5 questions selecting two questions from each of the two units with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory question comprising 07 short answer type questions carrying one mark each (total 07 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt three questions: the compulsory question no. 1 and 1 question from the each of the two units.			
Unit	Topics	CLO/s Attempt	Contact Hours
I	Resource Geology: Economic Geology (geological processes related to ore deposits), Mining Geology (application of geological knowledge to mining), Petroleum Geology (geological aspects of oil and gas exploration). Geological Data Analysis: Methods for collecting, interpreting, and presenting geological information.	CLO 1	15
II	Entrepreneurship Fundamentals: Introduction to the entrepreneurial mindset, identifying opportunities, and developing business ideas. Market Analysis: Understanding target markets, competition, and demand for geological services or products. Business Planning: Developing a comprehensive business plan, including market analysis, financial projections, and operational strategies. Financial Management: Understanding financial statements, budgeting, and securing funding.	CLO 2	15
Total Contact Hours			30
Suggested Evaluation Methods			
Internal Assessment: 15		End Term Examination: 35	
• Class Participation & Performance	5	Written Examination- 70 Marks	

• Seminar/presentation/assignment/quiz/class test etc.:	00												
• Mid-Term Exam:	10												
Part C-Learning Resources													
Recommended Books/e-resources/LMS:													
1. Advancing_Entrepreneurism_in_the_Geosciences by Harrison1, Laura Lyon1, Andre Marshall1, Mika McKinnon1, Leah Nichols1, Katherine Rubida1, Peter Schlosser1, Shaun Pal Smith1, and Shah Selbe1 2. INNOVATIVE ENTREPRENEURIAL VISTAS IN GEOINFORMATICS ENABLED GEOLOGICAL TECHNOLOGY February 2022 In book: Innovative Entrepreneurship (pp.117-136) Publisher: Independent Publication 3. Internet open sources. 4. Applied Geology: Approaches to Future Resource Management by Ashwani Kumar Tiwari and others. 5. Development Geology Reference Manual by AAPG. 6. Innovative Entrepreneurship by Palanivel Kathiresan. 7. Empowering geoscientists with entrepreneurial skills – bring back the ‘economics’ in economic geology course. 8. Acs, Z. J., Desai, S., & Hessels, J. (2008). <i>Entrepreneurship</i>, economic development and institutions. <i>Small Business</i>. Economics. 9. Applied Geology: Approaches to Future Resource. 10. Entrepreneurship and geography—some thoughts about a ... by R Sternberg													
Mapping of Course Learning Outcomes (CLOs) to Program Outcomes & Program Specific Outcomes													
CLOs	PO ₁	PO ₂	PO ₃	PO ₄	PO ₅	PO ₆	PO ₇	PO ₈	PO ₉	PO ₁₀	PO ₁₁	PSO ₁	PSO ₂
CLO ₁	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0	3.0	2.0
CLO ₂	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0	3.0	2.0
CLO ₃	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0	2.0	3.0
CLO ₄	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0	2.0	3.0
Content Mapping with NEP thrust areas													
Field												Hours devoted	
Employability												40	
Entrepreneurship												40	
Skill Enhancement												60	
Communication Development												0	
Indian Knowledge System												8	
Environmental Awareness/SDGs												60	
Current Issues and Social Awareness												40	
Gender issues												0	
Public policies												5	
Any Other												20	

Session: 2025-26			
Part A - Introduction			
Name of the Programme	M.Sc. Geology		
Semester	IV		
Name of the Course	Geology Lab-VII		
Course Code	26L6.5-GGY--411		
Course Type	PC-5		
Level of the course	500-599		
Pre-requisite for the course (if any)	NIL		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO1: To gain the practical knowledge about the Remote sensing data analysis. CLO2: To learn the Geo-informatics tool for Geoscience. CLO3: To understand the procedure for data collection related to palaeoecology, palaeoclimatology and Palaeogeography. CLO4: To learn the use of various proxies for study of Palaeoclimate, Paleogeography and Paleoecology.		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time	0	3 hours	
Part B- Contents of the Course			
Units	Content	CLO Attempted	Contact Hours
I	- Practice for Stereoscopic vision. - Numerical based on photogrammetry. - Visual interpretation of remote sensing data. - Practice on digital image processing	CLO1	30
II	- GPS data collection and integration with GIS. - Basic practice on GIS Software. - Maps preparation in GIS. - Practice on topology and thematic mapping in GIS	CLO2	30
III	- Exercise on Palaeogeographic reconstruction. - Palaeoclimatic data collection and interpretation.	CLO3	30
IV	- Palaeoecological data collection. - Palaeoecological data presentation and interpretation.	CLO4	30
Total			120
Suggested Evaluation Methods			
Internal Assessment: 30		End Term Examination: 70	
• Class Participation:	5	Lab record	10

• Seminar/Demonstration/Viva-voce/Lab records etc.:	10	Viva-Voce	20
• Mid-Term Exam:	15	write-up	40
Part C-Learning Resources			
1. Siegal B.S. and A.R. (1981). Remote sensing in Geology John Wiley & sons, 2. Miller V.C. and Miller C.F., (1971). Photogeology. McGraw Hill, 3. Lillesand T.M. and Kieffer, R.W. (2011), Remote sensing and image interpretation John Wiley & Sons. 4. Sabbins F.F., (1997). Remote principles and interpretations. W.H. Freeman Company. 5. Rao. D.P., (1999). Remote sensing for earth resources. AEG publications, Hyderabad. 6. Bradley, R. S. (2015). <i>Paleoclimatology: Reconstructing Climates of the Quaternary</i> , Academic Press. 7. Agrawal, D. P., Gupta, S. K., & Sharma, P. (Eds.). (1988). <i>Palaeoclimatic and Palaeoenvironmental Changes in Asia</i> . Indian National Science Academy. 8. Emiliani, C. (1992). <i>Planet Earth: Cosmology, Geology, and the Evolution of Life and Environment</i> . Cambridge University Press. 9. Smol, J. P., Birks, H. J. B., & Last, W. M. (Eds.). (2001). <i>Tracking Environmental Change Using Lake Sediments: Volume 1: Basin Analysis, Coring, and Chronological Techniques</i> . Kluwer Academic Publishers. 10. Walton, W.C., (1970). <i>Groundwater Resource</i> , McGraw Hill. 11. Raghunath, H.M., (1983) <i>Ground water</i> , Wiley Eastern Ltd.			

Mapping of Course Learning Outcomes (CLOs) to Program Outcomes & Program Specific Outcomes

CLOs	PO ₁	PO ₂	PO ₃	PO ₄	PO ₅	PO ₆	PO ₇	PO ₈	PO ₉	PO ₁₀	PO ₁₁	PSO ₁	PSO ₂
CLO ₁	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0	3.0	2.0
CLO ₂	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0	3.0	2.0
CLO ₃	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0	2.0	3.0
CLO ₄	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0	2.0	3.0

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	40
Entrepreneurship	40
Skill Enhancement	120
Communication Development	0
Indian Knowledge System	8
Environmental Awareness/SDGs	100
Current Issues and Social Awareness	60
Gender issues	0
Public policies	5
Any Other	20

Part A - Introduction			
Name of the Programme		M.Sc. Geology	
Semester		IV	
Name of the Course		Geology Lab-VIII	
Course Code		26L6.5-GGY-412	
Course Type		PC-6	
Level of the course		500-599	
Pre-requisite for the course (if any)		NIL	
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:		DEC-3 CLO1: To gain the practical knowledge about representation and interpretation of Geochemical data. CLO2: To understand the Physiography of oceans; and knowledge of paleoclimatic data. CLO3: To understand the procedure for the identification of Geo-tourism and Geo-heritage potential of a Geological site. CLO4: To understand the impact of Geoscience related activities on Environment. DEC-4 CLO1: To gain the practical knowledge about the techniques and operations in the mining. CLO2: To understand the core practices in disaster management. CLO3: To understand the practical tools related to Pleistocene data collection and interpretation. CLO4: To get the exposure of geological fieldwork for geological mapping.	
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time	0	3hours	
Part B- Contents of the Course			
Units	Content	CLO Attempted	Contact Hours
I	- Techniques of Sample preparation and Chemical analysis of rocks and minerals. - Problems based on radiometric systems. - Exercise based on interpretation of ocean floor maps. - Distribution of marine life & Major oceanic currents.	CLO1 & CLO2 of DEC-3	30
II	- Location maps of Geo-heritage sites in India. - Geology of Geo-heritage potential sites in India. - Investigating the impact of mining on groundwater quality. - Studying the effects of urbanization on soil erosion.	CLO3 & CLO4 of DEC-3	30

III	• Diagrammatic representation of open cast and underground mining. • Exercise on various techniques useful in Mineral Exploration & Mining. • The Project Report based on any two case studies among following disasters and one disaster preparedness plan of respective college or locality. • Case studies of some human induced disaster.	CLO1 & CLO2 of DEC-4	30
IV	• Exercises related to data collection and presentation in Quaternary/Pleistocene related projects. • Interpretation of data related to Quaternary/Pleistocene age related projects. • Geological fieldwork for identification of Earth material- Minerals, Rocks, Soil, Ore etc. • Exercise of Geological Maps preparation and Interpretations.	CLO3 & CLO4 of DEC-4	30
Total			120
Suggested Evaluation Methods			
Internal Assessment: 30		End Term Examination: 70	
• Class Participation:	5	Lab record	10
• Seminar/Demonstration/Viva-voce/Lab records etc.:	10	Viva-Voce	20
• Mid-Term Exam:	15	write-up	40
Part C-Learning Resources			
1. Mason, B. and Moore, C.B., 1991, <i>Introduction to Geochemistry</i>, Wiley Eastern. 2. Krauskopf, K.B., 1967, <i>Introduction to Geochemistry</i>, McGraw Hill. 3. Faure, G., 1986, <i>Principles of Isotope Geology</i>, John Wiley & Sons. 4. Hoefs, J., 1980, <i>Stable Isotope Geochemistry</i>, Springer-Verlag. 5. Wedepohl, K. H. 1971; <i>Geochemistry</i>. USA: Holt, Rinehart & Winston. 6. Siedler, G. et al. (2013) <i>Ocean Circulation and Climate: A 21st Century Perspective</i> (2nd Edition) Academic Press 7. Bradley, R.S. (2015) <i>Paleoclimatology: Reconstructing Climates of the Quaternary</i> (3rd Edition) Academic Press 8. Berger, A. et al. (2018) <i>Climate Change and Human Impact on the Landscape</i>, Springer 9. Rahmstorf, S. & (2018) <i>Our Threatened Oceans: Science and Solutions</i> Schellnhuber, H.J. Haus Publishing 10. Chester, R. & Jickells, T. (2020) <i>Marine Geochemistry</i> (4th Edition) Wiley-Blackwell. 11. C. Anze, L. Yunting and C.Y. Ng. Young (2015). <i>The Principles of Geotourism</i>, Science Press, Beijing 12. C.V. Burek and C.D. Prosser (2008). <i>The History of Geoconservation</i>, The Geological Society, London, Special Publications, 300 13. D.R. Reddy (2020). <i>A Monograph on Potential Geoparks of India</i>, INTACH, New Delhi 14. 36th IGC (2016). <i>Geotourism Hotspots of Indian Subcontinent</i>, GSI, New Delhi 15. C. Sharples (2002). <i>Concepts and Principles of Geoconservation</i>, Tasmanian Parks and Wildlife Service, Australia 16. Lindgren, L., (1986). <i>Environmental geology</i>, Prentice Hall. 17. Keller, E. A., (2000). <i>Environmental geology</i>, Pearson. 18. Angeletti, G., (1985). <i>Organic micro-pollutants in the aquatic environment</i>, Springer Science Business Media. 19. Strahler, A. N. and Strahler, A. H., (1973). <i>Environmental Geoscience: Interaction between natural systems and man</i>, John Wiley and Sons Inc.			

20. Marjoribanks, R. (2010). Geological Methods in Mineral Exploration and Mining. Springer Science & Business Media.
21. Peele R., (1966). Mining Engineers hand book, Wiley–Blackwell.
22. Mckinstry, H.E. (1960). Mining Geology. Asia publishing house
23. Ahmad, A. (2010): Disaster Management: Through the New Millennium, Anmol Publications, New Delhi.29
24. Bryant Edwards (2005). Natural Hazards, Cambridge University Press, U.K.
25. Bureau of Indian Standards (2002). Indian Standards: Criteria for Earthquake Resistant Design of Structures, Part I, Fifth Revision.
26. Burton, I., Kates, R.W. and White, G.F. (1993). Environment as Hazard, 2nd edition, Guilford Press, New York.
27. Krynine and Judd, (2005), *Engineering Geology*, New Delhi, CBS publishers.
28. Lambe, T.W. and Whitman, R., (2005) *Soil mechanics*, Wiley India Pvt Ltd.
29. Bharath Singh and Shamser, (1990) *Prakash Soil mechanics and foundation engineering, India: Nem Chand and Bros.*
30. Tsytovich, N.A., (1976) *Soil mechanics*, Central Books Ltd.
31. F.H.Lahee (2002) *Field geology*, 6 th ed. McGraw Hill, Publishers.
32. C.L.Dake and C.S.Brown. *Interpretation of topographic maps*,
33. J.W.Low (1957) *Geological field methods*, Harper & Brothers publishers.
34. R.R. Compton (1962) *Field Geology*, Wiley Publishers.
35. S.M.Mathur (2015) *Guide to Field Geology*, PHI Learning Private Limited, Delhi.
36. *Advancing Entrepreneurism in the Geosciences* by Harrison¹, Laura Lyon¹, Andre Marshall¹, Mika McKinnon¹, Leah Nichols¹, Katherine Rubida¹, Peter Schlosser¹, Shaun Pal Smith¹, and Shah Selbe¹
37. INNOVATIVE ENTREPRENEURIAL VISTAS IN GEOINFORMATICS ENABLED GEOLOGICAL TECHNOLOGY February 2022 In book: *Innovative Entrepreneurship* (pp.117-136) Publisher: Independent Publication

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁
CLO ₁	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₂	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
CLO ₃	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0
CLO ₄	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	30
Entrepreneurship	30
Skill Enhancement	120
Communication Development	0
Indian Knowledge System	8
Environmental Awareness/SDGs	100
Current Issues and Social Awareness	60
Gender issues	0
Public policies	5
Any Other	20

Part A – Introduction	
Name of the Programme	M.Sc. Geology
Semester	IV
Nature of Course	Dissertation/Project work
Name of the Course	Dissertation/Project work
Course Code	26L6.5-GGY-414
Course Level	500-599
Pre-requisite for the course (if any)	NIL
Course Outcomes (COs) After completing this course, the learner will be able to:	CLO1: To learn, how to outline the title of the project. CLO2: Understanding the importance of Literature review for a project or research work. CLO3: How to find the research gap. CLO4: Students will get knowledge to compile the data and report writing.
Credits	12
Contact Hours	08
Max. Marks	300 (Internal- 100 marks + External- 200)
Part B – Guidelines for the Dissertation Work/Project Work	
During the course of completion of the Dissertation work, a supervisor faculty member will assign a topic for dissertation/project work and the students will be required to complete various assignments given to them by their respective supervisors. For dissertation/Project related work, Students may go to other institutions for the analysis work or any specific assistance during vacations period. There may be a co-supervisor from other institution to guide the student for Dissertation/Project work.	
Tentative format of Dissertation/Project Work • General Introduction to the Study and Theoretical Framework • Review of Literature • Research Gap • Statement of the problem • Significance of the Study • Formulation of Research Questions /Issues • Research objectives • Hypotheses • Data source (Primary/Secondary) • Methodology • Analysis of Data • Discussion of the Results • Major findings, Summary, Recommendations (if any) and Conclusion • Bibliography /References &Webliography • Appendices	
Suggested Evaluation Methods	
(as per university guidelines)	
Internal Assessment: 100	End Term Examination: 200
Part C-Learning Resources	
Recommended Books/e-resources/LMS: Will be suggested by Supervisor/Co-supervisor as per title of dissertation/Project work.	

Mapping of Course Learning Outcomes (CLOs) to Program Outcomes & Program Specific Outcomes

CLOs	PO ₁	PO ₂	PO ₃	PO ₄	PO ₅	PO ₆	PO ₇	PO ₈	PO ₉	PO ₁₀	PO ₁₁	PSO ₁	PSO ₂
CLO ₁	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0	3.0	2.0
CLO ₂	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0	3.0	2.0
CLO ₃	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0	2.0	3.0
CLO ₄	1.0	1.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0	2.0	3.0