

मोहनलाल सुखाड़िया विश्वविद्यालय, उदयपुर
MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR



Syllabus of M.Sc. Tech (Applied Geology)

for

One – Year

Post Graduate M.Sc. Tech Applied Geology Program

As per the Choice Based Credit System (CBCS)

designed in accordance with Learning Outcomes – Based Curriculum Framework (LOCF) of
National Education Policy (NEP-2020)

I to II Semester M.Sc. Tech (Applied Geology) Courses

for Academic Year 2023-24

(Effective for the Academic Year 2023-24)

Faculty of Earth Sciences

(PG403XX)

Applied Geology in M.Sc. Tech Program: Semester wise course types, Course codes, Course title, Delivery type, Workload, Credits, Marks of Examination, and Remarks if any.

Level	Sem	Course Type	Course Code	Course Title	Delivery Type			Total Hours	Credits	Total Credits	Internal Assessment	EoS Exam	M.M	Remarks
					L	T	P							
9	I	DCC 1	GEO9004T	Applications of Tectonics and Structural Geology	L-3	T-1		60	4	4	20	80	100	
	I	DCC 2	GEO9005T	Applications of Palaeontology and Stratigraphy	L-3	T-1		60	4	4	20	80	100	
	I	DCC 3	GEO9006T	Applications of Remote Sensing	L-3	T-1		60	4	4	20	80	100	
	I	DCC PRAC T 1	GEO9002P	Applications of Tectonics and Structural Geology and Palaeontology - Stratigraphy			P-8	60	4	4	20	80	100	
	I	DCC + DSE PRAC T 2	GEO9003P	Remote Sensing and Mineral Technology, Economics and Policies / Exploration Geochemistry - Geophysics & Legislations in Mineral Industry			P-8	60	2+2	4	20	80	100	
	I	DSE 1	GEO9112T	Mineral Technology, Economics and Policies/	L-3	T-1		60	4 + 2	6	20	80	100	
	I		GEO9113T	Exploration Geochemistry - Geophysics & Legislations in Mineral Industry										
I	DCC + DSE PRAC T 2	GEO9112P	Remote Sensing and Mineral Technology, Economics and Policies/			P-8	60	2+2	4	20	80	100		
I		GEO9113P	Exploration Geochemistry - Geophysics & Legislations in Mineral											

			Industry										
II	DCC 4	GEO9007T	Advanced Mineral Exploration and Mining	L-3	T-1		60	4	4	20	80	100	
II	DCC 5	GEO9008T	Applied Hydrogeology	L-3	T-1		60	4	4	20	80	100	
II	DCC PRAC T 3	GEO9004P	Advanced Mineral Exploration and Mining and Applied Hydrogeology			P-8	60	4	4	20	80	100	
II	DSE 2	GEO9114T	Natural Resource Management/	L-3	T-1		60	4	4	20	80	100	
		GEO9115T	Palaeoceanography and Palaeoclimatology										
II	DSE 3	GEO9116T	Geoenvironment, Geohazards and Disaster management/	L-3	T-1		60	4	4	20	80	100	
		GEO9117T	Dissertation										
II	DSE PRAC T 4	GEO9114P	Natural Resource Management/			P-8	60	2	2	20	80	100	
		GEO9115P	Palaeoceanography and Palaeoclimatology										
II	DSE PRAC T 5	GEO9116P	Geoenvironment, Geohazards and Disaster management/			P-8	60	2	2	20	80	100	
		GEO9117S	*Dissertation										
Exit with M.Sc. Tech Certificate													

	Semester 1	Semester 2
Core 30Cr	DCC 1-4Cr Applications of Tectonics and Structural geology DCC 2- 4Cr Applications of Palaeontology and Stratigraphy DCC 3-4Cr Applications of Remote Sensing Pract.1 DCC (1 & 2) - 4 Cr Pract. 2 (DCC 3 & DSE 1) – (2Cr + 2Cr)	DCC 4- 4Cr Advanced Mineral Exploration and Mining DCC 5- 4 Cr Applied Hydrogeology Pract.3 DCC (4 & 5) - 4 Cr
Elective 18 Cr	DSE 1- 4Cr Mineral technology, Economics and Policies / Exploration Geochemistry - Geophysics & Legislation in Mineral Industry Pract. 2 (DCC 3 & DSE 1) – (2Cr + 2Cr)	DSE 2- 4Cr Natural Resource Management / Palaeoceanography and Palaeoclimatology DSE 3- 4Cr Geoenvironment, Geohazards and Disaster Management / *Dissertation Pract. 4 DSE 2 - 2Cr Pract. 5 DSE 3 - 2Cr
48 Cr	18+6=24 Cr	12+12= 24 Cr

1. For DSE paper in M.Sc. Tech there should be at least 6 students out of the total 18 seats to start a DSE paper in an academic session.
2. * Dissertation report will be submitted by the candidate for 6 credit calculation under the guidance of a mentor/guide which will be a faculty member, marks of internal on dissertation will be given by the mentor/ faculty member. Evolution of dissertation report will be done as per the guidelines of NEP of MLS University. Dissertation/ Summer Internship under category of special types of delivery of course.

EOES (For Theory):

1. External Exam

a.	Section A	20 Marks
b.	Section B	40 Marks
c.	Section C	20 Marks
Total		80 Marks

2. Internal Exam **20 Marks**

Pass Percentage - 40%

EOSE (For DSE Practical):		
1. Practical	- 45 Marks	80 Marks
2. Viva – Voce	- 15 Marks	
3. Record	- 20 Marks	
4. Internal Exam	-	20 Marks
i. Exam	- 10 Marks	
ii. Assignment/ Seminar/Quiz	- 10 Marks	



M.Sc. Tech (Applied Geology) Ist Semester

Code of the course	GEO9004T
Title of the course	Applications of Tectonics and Structural Geology
Level of the course	NHEQF Level 7.0
Credit of the course	4
Type of the course	Discipline Centric Core Course (DCC)
Delivery type of the course	Theory & Lecture
Objectives of the Course	<ul style="list-style-type: none"> • Accurate geometric description of the structures observed in naturally deformed rocks. Understanding deformation mechanisms at macroscopic and micro- meso scales.
Syllabus	
<u>Semester-1 Applications of Tectonics and Structural Geology</u>	
Unit 1 Plate Tectonics	
Mechanism and Implications of Plate Tectonics. Mineralization in relation to Plate Tectonics. Plate boundaries in relation to extensional, compressional and transpressional tectonics. Tectonics of Orogenic belts and Supercontinent Cycle.	
Unit 2 Seismotectonics	
Interplate and Intraplate Seismicity. Earthquake Seismology. Himalayan Earthquakes. Reservoir induced Seismicity. Seismic Hazards and Tomography. Neotectonic: Evidences with examples.	
Unit 3 Deformation Processes	
Analyses of deformation- Behaviour of rocks under stress, Estimation of palaeostress, Homogenous and Heterogenous deformation, Progressive Deformation. Strain Paths and Measurements. Role of fluids in deformation processes.	
Unit 4 Microstructures	
Types, Orientation, Slip & Rotation. Static and Dynamic Recrystallization and their effects. Lattice Preferred Orientation, Dilation sites, Porphyroblasts and Reaction rims. Controls of strain rate and temperature on microstructures.	
Unit 5 Structural Analyses	
Time relation between crystallization and deformation. Basement Cover relationship. Criteria of recognition of polyphase deformation. Rotation of structural elements. Analyses of complex deformation structures.	
Books suggested for reading:	
<ul style="list-style-type: none"> • Hobbs, B.E., Means, W.D. and Williams, P.F. John Wiley, 1976, An outline of Structural Geology. • Ramsay, J.G. and Mc Graw Hill, 1967, Folding and Fracturing of Rocks. • Davis, H., Stephen J. Reynolds and Chuck Kluth, Structural Geology of Rocks and Regions/George, 3rd edition. • Park, R.G., 1997, Foundations of Structural Geology, 3rd edition. 	

- Haakon Fossen, 2010, Structural Geology.
- Ghosh, S.K., 1993, Structural Geology– Fundamentals and Modern development.
- Passchier, C.W. and Trouw, R.A.J., 2005, Microtectonics.
- Billings, M.P., 2001, Structural Geology, Prentice Hall of India Pvt. Ltd., Delhi, 606p.
- Ramsay, J.G. and Huber, M.L., 1987, Modern Structure Geology, Vol. I & II. Academic Pres.
- James, Mc.Calpin, 1996, Paleoseismology Academic Academic Pres.

Suggested E-resources

- egyankosh.ac.in
- <http://egyankosh.ac.in/handle/123456789/53276>
- [BGYCT-131 Physical and Structural Geology](#)
- <https://egyankosh.ac.in/handle>
- https://epgp.inflibnet.ac.in/epgp_content
- <https://ocw.mit.edu/courses/12-113-structural-geology-fall-2005/pages/lecture-notes>

Course learning outcomes

- Students are supposed to learn the techniques of recording and analyzing structural data and to map rock sequences in the field and interpret a region to determine how it formed and what has happened to the area since formation. To come out with the application of structural geology in various diverse fields of Geology.

Code of the course	GEO9005T
Title of the course	Applications of Palaeontology And Stratigraphy
Level of the course	NHEQF Level 7.0
Credit of the course	4
Type of the course	Discipline Centric Core Course (DCC)
Delivery type of the course	Theory & Lecture
Objectives of the Course	<ul style="list-style-type: none"> • It is aimed to make understand the application and Significance of paleofauna's and paleoflaura. • It is aimed to make understand of Earth's geological history through this paper by pertaining knowledge of lithology, crustal evolution and geochronology.
Syllabus	
<u>Semester-1 Applications of Palaeontology And Stratigraphy</u>	
Unit 1 Organic Evolution	
Origin of Life, Punctuated equilibrium and Phyletic Gradualism Models. Palaeoecology, Palaeobiogeography. Taphonomic considerations. Mass extinctions	
Unit 2 Applications of Microfossils	
Microfossils: Types & Significance. Usage in seafloor tectonism, Oxygen and Carbon isotope studies of microfossils. Palaeoclimatic and Paleogeographic inferences from microfossils	
Unit 3 Palyonology	
Geological history and morphology of pollen grains. Palyonology in Petroleum, Coal and CBM exploration.	
Unit 4 Stratigraphic applications	
Magneto-stratigraphy, Chemostratigraphy, Bio-stratigraphy, Methods of Palaeogeographic reconstruction. Sequence stratigraphy through Carbon, Oxygen and Sulphur stable isotopes.	
Unit 5 Geochronology	
Pb-Pb, U-Pb, Sm-Nd, K-Ar, Ar-Ar and Rb-Sr dating methods and their applications. Quaternary dating methods: Radiocarbon dating, luminescence, uranium series & amino acids	
Books suggested for reading:	
<ul style="list-style-type: none"> • Vaidyanadhan, R. and Ramakrishnan, M., 2010, Geology of India vol. I & II, Geol. Soc. of India, Bangalore. • Roy, A.B., Purohit, R. and Elsevier, 2018, Indian Shield. • Kumar, Ravindra., 1988, Fundamentals of Historical Geology and Stratigraphy of India. • Gupta, V.J., 1973, Indian Palaeozoic Stratigraphy, Hindusthan Publishing Corporation • Gupta, V.J., 1975, Indian Mesozoic Stratigraphy, Hindusthan Publishing Corporation • Gupta, V.J., 1976, Indian Cenozoic Stratigraphy, Hindusthan Publishing Corporation • Krishnan, M.S., Geology of India and Burma, Higginbothams (P) Ltd. 	

- Pomeroy, C., 1982, The Cenozoic Era: Tertiary and Quaternary, Ellis Harwood Ltd.
- Black, R.M., 1988, The Elements of Palaeontology, Cambridge Univ.
- Clarkson, E.N.K., 1986, Invertebrate Palaeontology and Evolution, Allen and Unwin Publ.
- Saraswati, P.K. and Srinivasan, M.S., 2016, Micropaleontology: Principles and Applications, Springer.
- Arnold, Haslett and Ed. Simon K, 2002, Quaternary Environmental Micropaleontology., Oxford
- Haq, B. U., Boersma, A. and Elsvier, 1998, Introduction to Marine Micropaleontology,.

Suggested E-resources :

- <https://egyankosh.ac.in/bitstream/123456789/69603/1/Block-2.pdf>
- https://en.wikipedia.org/wiki/Geology_of_India
- https://www.researchgate.net/publication/248552540_Stratigraphic_setting_of_the_Phanerozoic_rocks_along_the_northern_boundary_of_the_Indian_Plate
- <https://www.youtube.com/watch?v=5ALNHhocXZY&list=PLtmeb20f7jz-Q5YwTpgUefo4N3X9bkiC8>
- <https://www.futurelearn.com/courses/extinctions-past-present/19/steps/1312906>

Course learning outcomes :

- Students are expected to carry with them knowledge based upon geochronological sequence of rock layers all over during the earth's history. The knowledge imparted will bear characterization of Stratigraphic rocks with respect to lithology, structure, extension, location, age & life preserved , if any.
- Students are expected to get knowledge to find fauna and flora in the stratigraphic sequence and able to put these in an evolutionary trend.

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Code of the course	GEO9006T
Title of the course	Applications of Remote Sensing
Level of the course	NHEQF Level 7.0
Credit of the course	4
Type of the course	Discipline Centric Core Course (DCC)
Delivery type of the course	Theory & Lecture
Objectives of the Course	<ul style="list-style-type: none"> • To develop concepts and applications of Remote Sensing and GIS in Geology.
Syllabus	
<u>Semester-1 Applications of Remote Sensing</u>	
Unit 1 Introduction to Remote Sensing	
Principles and significance; Electromagnetic Radiation – Characteristics and Remote Sensing Regions and bands; Spectra of common natural objects – soil, rock, water and vegetation; General Orbital characteristics of satellites; Concepts of radiometric, spectral, spatial and temporal resolutions of satellite sensors.	
Unit 2 Microwave and Thermal Remote Sensing	
Sensor characteristics of remote sensing satellites: Landsat, IRS, ASTER, Quickbird, Microwave remote sensing, Thermal and infrared remote sensing and their applications.	
Unit 3 Hyperspectral Remote Sensing	
Introduction to Hyperspectral Remote Sensing, Imaging Spectrometers, Spectral Libraries, Hyperspectral Sensors, Applications of Hyperspectral Remote Sensing in Geology.	
Unit 4 Digital Image Processing	
Image rectification and restoration; Image enhancement, contrast stretching, filtering, Image rationing; Image classification and accuracy assessment - supervised & unsupervised classification, error estimation; Data merging and GIS integration.	
Unit 5 Concept of GIS	
Definition and components of GIS; Raster, vector, Spatial and non spatial data structures; Data Based Management Systems and Model; Spatial Analysis: Spatial elements and analysis, local, focal, zonal and global operations; GIS query and output, Digital Elevation Model (DEM) and its derivatives; Utility of GIS in Geological projects.	
Books suggested for reading:	
<ul style="list-style-type: none"> • Sabbins, F.F., 1985 Remote Sensing-Principles and Applications. Freeman • Lillesand, T.M. and Kieffer, R.W., 1987, Remote Sensing and Image Interpretation- John wiley • Demers, M., Fundamentals of GIS • Finkiel, 104, Encyclopedia of Applied Geology • Reddy, M. Anji., Remote Sensing and Geographical Information System • Chandra, A.M., Remote sensing and Geographic Information System • Jensen, A.R., Remote Sensing of Environment • Joseph , George., Fundamentals of Remote Sensing 	

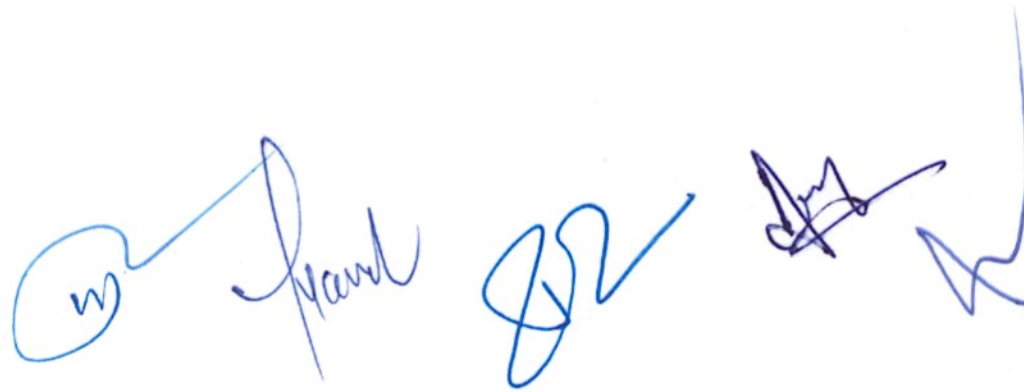
Suggested E-resources

- <https://vidyamitra.inflibnet.ac.in/index.php/search?subject%5B%5D=Geology&course%5B%5D=Remote+sensing+and+GIS+%28GEL11%29&domain%5B%5D=Physical+%26+Basic+Sciences>
- <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=8zYwEsyFCoiPyJIPmzHDxg==>

Course learning outcomes

Upon successful completion of course the students would be able to:

- To understand the characteristics of various sensors and satellite missions.
- To understand the role of remote sensing and GIS in Geological studies.
- To understand the concepts of Microwave, Thermal and Hyperspectral Remote Sensing and its applications.
- To develop concepts of GIS and its applications.



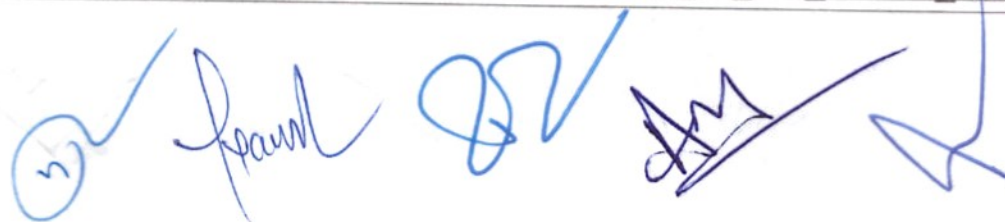
Code of the course	GEO9002P
Title of the course	Applications of Tectonics and Structural Geology and Applications of Palaeontology
Level of the course	NHEQF Level 7.0
Credit of the course	4
Type of the course	Discipline Centric Core Course (DCC)
Delivery type of the course	Practical
Objectives of the Course	<ul style="list-style-type: none"> • To learn the practice of theoretical knowledge for applying at ground observation in field and to learn essential observational and practical skills • To impart understanding of the basic and advanced concepts of as well as various applications of remote sensing and GIS. • Students with physically observed the rocks, it will help them to identify rocks in the field and build a tectonic model. • Students get idea about the fauna and learn to calculate the age through isotops.
Syllabus	
<u>Applications of Tectonics and Structural Geology and Applications of Palaeontology and Stratigraphy</u>	
Applications of Tectonics and Structural Geology	
<ul style="list-style-type: none"> • Solution of structural problems by stereographic and orthographic projections / Plot Series Maps. • Identification of structural elements and their chronology in hand specimen. • Structural analysis with stereonet: S- pole and beta- pole diagrams; Fold axis and axial plane; Countoured diagrams; Methodology and interpretation of patterns. • Interpretation of complex geological maps and drawing of cross section. 	
Applications of Palaeontology and Stratigraphy	
<ul style="list-style-type: none"> • Age calculation exercise through various Isotope dating methods • Lab Study of rocks • Lab study of Microfauna • Isotope study of faunas for age calculation exercises. 	
<u>Compulsory Field Training Program:</u> Geological Field Training mainly based on Structural Mapping.- 10 days duration.	
Note: <u>Compulsory field training program at the end of every semester will be value added part of the practical syllabus which will be of 10 days duration and students opting out of it will loose proportional marks from the practical credit score. The student will have chance to improve the score by doing the field training at his/her own expenses before the commencement of final practical exam and after producing valid certificate from the recognized institute/company duly approved by the field training mentor/ faculty member.</u>	

Books suggested for reading:

- Ramsay, J.G., and Hill, Mc. Graw., 1967, Folding and Fracturing of rocks
- Park, R.G., 1997, Foundations of Structural Geology, 3rd edition.
- Ghosh, S.K., 1993, Structural Geology– Fundamentals and modern development.
- Passchier, C.W. and Trouw, R.A.J., 2005, Microtectonics.
- Billings, M.P., 2008, Structural Geology, 3rd Edition, Prentice Hall of India Pvt. Ltd., Delhi, 606p.
- Ramsay, J.G. and Huber, M.L., 1987, Modern Structure Geology- Vol. I & II, Academic Pres.
- Gokhale, N.W., 2001, A Guide to Field Geology.
- Platt. John I., Selected Exercises upon Geological Maps, London WCI.
- Ragan, Practical Structure Geology.
- Jensen, J.R., 1996, Introductory Digital Image Processing, A Remote Sensing Perspective, Springer- Verlag.
- Lillesand, T. M. and Kiefer, R.W., 2007, Remote Sensing and Image Interpretation, Wiley.
- Richards, J.A. and Jia, X., 1999, Remote Sensing Digital Image Analysis, Springer-Verlag
- Gupta, R.P., 1990, Remote Sensing Geology, Springer Verlag
- Vaidyanadhan, R. and Ramakrishnan, M., 2010, Geology of India vol. I & II, Geol. Soc. of India, Bangalore.
- Roy, A.B., Purohit, R. and Elsevier, 2018, Indian Shield.
- Gupta V.J., 1973, 1975, 1976, Indian Palaeozoic Stratigraphy. Hindusthan Publishing Corporation
- Krishnan, M.S., Geology of India and Burma. Higginbothams (P) Ltd.
- Black, R.M., 1988, The Elements of Palaeontology, Cambridge Univ.
- Clarkson, E.N.K., 1986, Invertebrate Palaeontology and Evolution, Allen and Unwin Publ.
- Saraswati, P. K. and Srinivasan, M. S., 2016, Micropaleontology, Principles and Applications, Springer.

Suggested E-resources

- egyankosh.ac.in
- <http://egyankosh.ac.in/handle/123456789/53276>
- [BGYCT-131 Physical and Structural Geology](#)
- <https://egyankosh.ac.in/handle>
- https://epgp.inflibnet.ac.in/epgp_content
- <https://ocw.mit.edu/courses/12-113-structural-geology-fall-2005/pages/lecture-notes>
- <https://egyankosh.ac.in/bitstream/123456789/69603/1/Block-2.pdf>
- https://en.wikipedia.org/wiki/Geology_of_India
- <https://www.researchgate.net/publication/248552540> Stratigraphic setting of the Palaeozoic rocks along the northern boundary of the Indian Plate



- http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000010ES/P001694/M020138/ET/1494502494046.N011.ES07-273BiostratigraphyANReddy.pdf
- <https://igntu.ac.in/eContent/MSc-Geology-02Sem-DrVikramSingh-MICROPALEONTOLOGY.pdf>
- <https://vidyamitra.inflibnet.ac.in/index.php/search?subject%5B%5D=Geology&course%5B%5D=Remote+sensing+and+GIS+%28GEL11%29&domain%5B%5D=Physical+%26+Basic+Sciences>
- <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=8zYwEsyFCoiPyJlPmzHDxg==>

Course learning outcomes

- To train the students for adaptation in field work environment in certain professional and scientific organizations. Students will have knowledge which will be imparted through field trips. Students are expected to learn different deformational structures.
- Lab Exercises independently on various Visual and Digital Image processing techniques.
- Lab Exercises independently on Applications of ERDAS / Q GIS in Geosciences.
- Study will help students in the field to work on rocks.
- Faunal study will help them to identify fauna in the field and to put these in the evolutionary sequence.

EOSE:		
1. Practical	- 45 Marks	80 Marks
2. Viva – Voce	- 15 Marks	
3. Record	- 20 Marks	
	i. Field Tour Report – 10 Marks ii. Practical Record – 10 Marks	
4. Internal Exam	-	20 Marks
	i. Exam - 10 Marks ii. Assignment/ Seminar/Quiz – 10 Marks	



Code of the course	GEO9003P
Title of the course	Applications of Remote Sensing & DSE 1
Level of the course	NHEQF Level 7.0
Credit of the course	4
Type of the course	Discipline Centric Core Course (DCC)
Delivery type of the course	Practical
Objectives of the Course	<ul style="list-style-type: none"> • To impart an understanding of the basics of aerial photography and photogrammetry. • To impart an understanding of the fundamentals of remote sensing components. • To gain knowledge about ERDAS Software and its application. • To gain knowledge of Geographic Information Systems (GIS)
Syllabus	
<u>Applications of Remote Sensing & DSE 1</u>	
Applications of Remote Sensing	
<ul style="list-style-type: none"> • Hands on exercises on Digital Image Processing Techniques Using ERDAS such as Image loading and display/registration, Image masking, Image mosaicking, Sub set image registration, Image enhancement). • Hands on exercises on applications of GIS in the field of Geosciences using QGIS/ Arc GIS. 	
Books suggested for reading:	
<ul style="list-style-type: none"> • Jensen, J.R., 1996, Introductory Digital Image Processing, A Remote Sensing Perspective, Springer- Verlag. • Lillesand, T. M. and Kiefer, R.W., 2007, Remote Sensing and Image Interpretation, Wiley. • Richards, J.A. and Jia, X., 1999, Remote Sensing Digital Image Analysis, Springer-Verlag • Gupta, R.P., 1990, Remote Sensing Geology, Springer Verlag 	
Suggested E-resources	
<ul style="list-style-type: none"> • https://vidyamitra.inflibnet.ac.in/index.php/search?subject%5B%5D=Geology&course%5B%5D=Remote+sensing+and+GIS+%28GEL+11%29&domain%5B%5D=Physical+%26+Basic+Sciences • https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=8zYwEsyFCoiPyJIPmzHDxg== 	
Course learning outcomes	
<ul style="list-style-type: none"> • Understanding of various types of aerial photographs and their scale • Understanding the basic components of Remote Sensing • Students may be able to understand the functioning, data acquisition, and orbit operations of missions. • Students will able to understand the various components of ERDAS and GIS software 	

and its Applications	
EOSE (Practical):	80 Marks
DCC 3 + DSE 1	
Practical - 45 Marks	
Viva – Voce - 15 Marks	
Record - 20 Marks	20 Marks
Internal Exam -	
<ul style="list-style-type: none"> i. Exam - 10 Marks ii. Assignment/ Seminar/Quiz – 10 Marks 	

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Code of the course	GEO9003P
Title of the course	Mineral Technology, Economics and Policies
Level of the course	NHEQF Level 7.0
Credit of the course	4
Type of the course	Discipline Specific Elective (DSE)
Delivery type of the course	Theory & Lecture
Objectives of the Course	<p>The objectives of this course are to:</p> <ul style="list-style-type: none"> • To acquire knowledge of applied concept of mineral processing and economics of mineral resources. • To understand how and why different types of mineral deposits are formed. • Understand the importance of mineral processing technology. • Understand techniques of mineral processing for concentration of ore minerals economically. • To understand various government mineral policies, rules and regulations for conservation of minerals.
Syllabus	
<u>Semester-1 Mineral Technology, Economics and Policies</u>	
Unit 1 Principles of ore dressing	
Principles of ore dressing. Comminution-breaking, crushing and grinding. Principles and methods of screening and classification. Filtration. Methods of Concentration - Hand sorting, Washing, Gravity concentration, Heavy media separation, Flotation, Magnetic, Electrostatic and other methods. Study of mineral dressing processes of important ores and Industrial minerals in India.	
Unit 2 Non-Metallic minerals	
Non-Metallic minerals: State-wise distribution of the resources, production, exports and imports, industrial uses and specifications of the important non- metallic minerals of India and their world scenario.	
Unit 3 Metallic minerals	
Metallic minerals: State-wise distribution of the resources, production, consumption and uses, exports and imports of the important metallic minerals of India and their world scenario.	
Unit 4 Energy and fuel minerals	
Energy and fuel minerals: State-wise distribution, production, consumption, exports and imports of the important energy and fuel minerals of India and their world scenario.	
Unit 5 Mineral rules and regulations	
Peculiarities of mineral deposits. Conservation and substitution of minerals. Mineral concession rules of India. National mineral policy. Mineral policy of Rajasthan; Granite and Marble policy. Strategic, critical and essential minerals.	
Books suggested for reading:	

- Wills, B. A., Mineral processing technology.
- Gaudin, A.M., Principles of Mineral Dressing.
- Taggart, A. F., Elements of Ore Dressing.
- Wills, Barry A., Mineral Processing Technology, An Introduction to the Practical Aspects of Ore Treatment and Mineral Recovery.
- Dahlkamp, F.J., 1993, Uranium Ore Deposits, Springer Verlag.
- drzymala, Jan, 2007, Mineral Processing.
- Fuerstenau, Maurice C., 2008, Principles of mineral processing.
- Evans, A.M., 1993, Ore Geology and Industrial Mineral, Blackwell
- Guilbert, J.M. and Park, Jr. C.F., 1986, The Geology of Deposits. Freeman
- Holson, G.D. and Tiratsoo, E.N., 1985, Introduction to Petroleum Geology, Gulf Publ. Houston, Texas.
- Jansen, M.L. and amp, Bateman, A.M., 1981, Economic Mineral Deposits, John Wiley & amp; Sons, Singapore.
- Klemm, D.D. and Schneider, H.J., 1977, Time and Strata Bound Ore Deposits, Springer Verlag.
- Mookherjee, A., 2000, Ore Genesis – a Holistic Approach, Allied Publisher.
- Selley, R.C., 1998, Elements of Petroleum Geology, Academic Press.
- Singh, M.P., 1998, Coal and Organic Petrology. Hindustan Publ., New Delhi.

Suggested E-resources

- https://assets.cambridge.org/97811070/74910/frontmatter/9781107074910_frontmatter.pdf
- https://www.researchgate.net/publication/342465286_An_Introduction_to_Mineral_Economics_Role_of_Geologist
- <https://ibm.gov.in/>

Course learning outcomes

Upon successful completion of course the students would be able to

- Understand the technology of the minerals processing and implication of the mineral resources in different industries.
- Students gain the knowledge about different government policies and regulations of minerals.
- Students will be able to know how economy is governed by various type of minerals.

Code of the course	GEO9112P
Title of the course	Mineral Technology, Economics and Policies
Level of the course	NHEQF Level 7.0
Credit of the course	2
Type of the course	Discipline Specific Elective (DSE)
Delivery type of the course	Practical
Objectives of the Course	<ul style="list-style-type: none"> As per the objectives defined in theory paper with the aim to develop practical skills.
Syllabus	
<u>Semester-1 Mineral Technology, Economics and Policies</u>	
PRACTICALS	
<ul style="list-style-type: none"> Flow sheets of beneficiation of important ore minerals. Industrial specification of important industrial minerals. Study of important metallic and non- metallic minerals in hand specimen. 	
Books suggested for reading:	
<ul style="list-style-type: none"> Wills, B. A., Mineral processing technology. Gaudin, A.M., Principles of Mineral Dressing. Taggart, A. F., Elements of Ore Dressing. Wills, Barry A., Mineral Processing Technology, An Introduction to the Practical Aspects of Ore Treatment and Mineral Recovery. Dahlkamp, F.J., 1993, Uranium Ore Deposits, Springer Verlag. drzymala, Jan, 2007, Mineral Processing. Fuerstenau, Maurice C., 2008, Principles of mineral processing. Evans, A.M., 1993, Ore Geology and Industrial Mineral, Blackwell. Guilbert, J.M. and Park, Jr. C.F., 1986, The Geology of Deposits, Freeman. Holson, G.D. and Tiratsoo, E.N., 1985, Introduction to Petroleum Geology, Gulf Publ. Houston, Texas. Jansen, M.L., amp, and Bateman, A.M., 1981, Economic Mineral Deposits, John Wiley & Sons, Singapore Klemm, D.D. and Schneider, H.J., 1977, Time and Strata Bound Ore Deposits, Springer Verlag. Mookherjee, A., 2000, Ore Genesis – a Holistic Approach, Allied Publisher. Selley, R.C., 1998, Elements of Petroleum Geology, Academic Press. Singh, M.P.(Ed.), 1998, Coal and Organic Petrology. Hindustan Publ., New Delhi 	
Suggested E-resources	
<ul style="list-style-type: none"> https://assets.cambridge.org/97811070/74910/frontmatter/9781107074910_frontmatter.pdf https://www.researchgate.net/publication/342465286_An_Introduction_to_Mineral_Economics_Role_of_Geologist https://ibm.gov.in/ 	

Course learning outcomes	
<ul style="list-style-type: none"> As per the outcomes defined in theory paper with relevance to practical aspects. 	
EOSE (Practical):	80 Marks
DCC 3 + DSE 1	
Practical - 45 Marks	
Viva – Voce - 15 Marks	
Record - 20 Marks	20 Marks
Internal Exam -	
iii. Exam - 10 Marks	
iv. Assignment/ Seminar/Quiz – 10 Marks	

Code of the course	GEO9113T
Title of the course	Exploration Geochemistry - Geophysics & Legislation in Mineral Industry
Level of the course	NHEQF Level 7.0
Credit of the course	4
Type of the course	Discipline Specific Elective (DSE)
Delivery type of the course	Theory & Lecture
Objectives of the Course	<p>The objectives of this course are to:</p> <ul style="list-style-type: none"> • Familiarize with procedures and techniques of mineral exploration. • Understand the geochemical methods applied in mineral exploration. • Understand the geophysical methods applied in mineral exploration. • Understand various rules and regulations related with mineral industry in India, and. • Increase and update the knowledge and skills required by geoscientists for the exploration and exploitation of mineral deposits.
Syllabus	
<u>Semester-2 Exploration Geochemistry - Geophysics & Legislation in Mineral Industry</u>	
Unit 1 Introduction	
Introduction to Mineral Exploration, Mineral Policies across the world, Classification of mineral deposits, Industry Specifications.	
Unit 2 Exploration Geology	
Introduction to Exploration Geology, Regional Planning and Organization, Surface Guides, Survey and Mapping. Geological exercises in mineral exploration.	
Unit 3 Exploration Geochemistry	
Exploration Geochemistry: Distribution and dispersion of elements, Background and threshold values, Orientation Survey, Standard Operation Procedures in Geochemical Exploration, Analytical Methods, Data Interpretation and Geochemical Methods of Mineral Exploration.	
Unit 4 Exploration Geophysics	
Exploration Geophysics: Introduction to geophysical methods, Seismic survey (Reflection and Refraction methods), Gravity survey, Magnetic survey, Electrical survey (Resistivity, IP and SP methods).	
Unit 5 Mineral Policy	
Strategic, critical and essential minerals; India's status in mineral production; co-products and byproducts; consumption, substitution and conservation of minerals; National Mineral Policy; Mineral Concession Rules; UNFC Mineral Auctions Rules; marine mineral resources and laws of the sea.	
Books suggested for reading:	

- Kearey, Philip., Brooks, Michael and Hill, Ian, 2002, An Introduction to Geophysical Exploration, 3rd Edition, ISBN: 978-0632049295 Publisher Wiley-Blackwell, Importer CBS Publishers.
- Mamdouh, R., Ray, Gadallah. and Fisher, 2008, Exploration Geophysics, Science & Business Media, ISBN 3540851607, 9783540851608.
- Macheyekei , Athanas S., Kafumu, Peter, Dalaly., Li, Xiaohui., Yuan Feng and Elsevier, 2020, Applied Geochemistry, Advances in Mineral Exploration Techniques 1st Edition, ISBN: 978-0128194959.
- Charles, Moon., Michael, Whateley, K.G., and Anthony, M. Evans., 2009, Introduction to Mineral Exploration, 2nd Edition, ISBN: 978-1-444-30912-6 March 2009 Wiley-Blackwell.
- Reedman, J. H., Techniques in Mineral Exploration, 1st Edition, ISBN: 978-94-009-9229-0, Springer Dordrecht, XII.
- Haldar, S.K. and Elsevier, 2018, Mineral Exploration, Principles and Applications, Second Edition, ISBN 9780128140222.

Suggested E-resources

- <https://nptel.ac.in/courses/105103182>
- <https://ocw.mit.edu/courses/12-201-essentials-of-geophysics-fall-2004/>
- <https://ibm.gov.in/writereaddata/files/07172017104116Elements%20of%20Mineral%20Exploration.pdf>
- <https://earthresources.vic.gov.au/community-and-land-use/understanding-exploration>
- https://onlinecourses.nptel.ac.in/noc22_ce35/preview

Course learning outcomes

- On completion of this course, students will be able to:
- Understand the principles, techniques and application of geochemical methods in mineral exploration
- Understand the principles, techniques and application of geophysical methods in mineral exploration
- Understand the various applicable rules and regulations which are related to mineral industry in the country

Code of the course	GEO9113P
Title of the course	Exploration Geochemistry - Geophysics & Legislation in Mineral Industry
Level of the course	NHEQF Level 7.0
Credit of the course	2
Type of the course	Discipline Specific Elective (DSE)
Delivery type of the course	Practical
Objectives of the Course	<ul style="list-style-type: none"> As per the objectives defined in theory paper with the aim to develop practical skills.
Syllabus	
<u>Semester-2 Exploration Geochemistry - Geophysics & Legislation in Mineral Industry</u>	
PRACTICALS	
<ul style="list-style-type: none"> Literature review and/or Field based exploration project. End term examination will be based on project report and viva voce. 	
Books suggested for reading:	
<ul style="list-style-type: none"> Kearey, Philip., Brooks, Michael and Hill, Ian, 2002, An Introduction to Geophysical Exploration, 3rd Edition, ISBN: 978-0632049295 Publisher Wiley-Blackwell, Importer CBS Publishers. Mamdouh, R., Ray, Gadallah. and Fisher, 2008, Exploration Geophysics, Science & Business Media, ISBN 3540851607, 9783540851608. Macheyeki , Athanas S., Kafumu, Peter, Dalaly., Li, Xiaohui., Yuan Feng and Elsevier, 2020, Applied Geochemistry, Advances in Mineral Exploration Techniques 1st Edition, ISBN: 978-0128194959. Charles, Moon., Michael, Whateley, K.G., and Anthony, M. Evans., 2009, Introduction to Mineral Exploration, 2nd Edition, ISBN: 978-1-444-30912-6 March 2009 Wiley-Blackwell. Reedman, J. H., Techniques in Mineral Exploration, 1st Edition, ISBN: 978-94-009-9229-0, Springer Dordrecht, XII. Haldar, S.K. and Elsevier, 2018, Mineral Exploration, Principles and Applications, Second Edition, ISBN 9780128140222. 	
Suggested E-resources	
<ul style="list-style-type: none"> https://nptel.ac.in/courses/105103182 https://ocw.mit.edu/courses/12-201-essentials-of-geophysics-fall-2004/ https://ibm.gov.in/writereaddata/files/07172017104116Elements%20of%20Mineral%20Exploration.pdf https://earthresources.vic.gov.au/community-and-land-use/understanding-exploration https://onlinecourses.nptel.ac.in/noc22_ce35/preview 	
Course learning outcomes	
<ul style="list-style-type: none"> As per the outcomes defined in theory paper with relevance to practical aspects. 	
EOSE (Practical):	80 Marks
DCC 3 + DSE 1	

Practical	- 45 Marks	
Viva – Voce	- 15 Marks	
Record	- 20 Marks	
Internal Exam	-	20 Marks
i.	Exam - 10 Marks	
ii.	Assignment/ Seminar/Quiz – 10 Marks	

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M.Sc. Tech Applied Geology IIst Semester

Code of the course	GEO9007T
Title of the course	Advanced Mineral Exploration and Mining
Level of the course	NHEQF Level 7.0
Credit of the course	4
Type of the course	Discipline Core Course (DCC)
Delivery type of the course	Theory & Lecture
Objectives of the Course	<ul style="list-style-type: none"> • This course is designed to enable students to acquire understanding of the advance concepts of mineral exploration, exploration techniques including ground and aero geophysical surveys, geochemical exploration, etc., knowledge of application of ore petrography.
Syllabus	
<u>Semester-2 Advanced Mineral Exploration and Mining</u>	
Unit 1 Exploration and Mining Geology	
Outline of Growth and Development of Mining Geology. Gathering and presenting geological data including geologic mapping in underground mines. Ore search and guides. Drilling for geologic information, Planning of drill holes and logging of drill hole data.	
Unit 2 Sampling	
Sampling ore bodies and Estimation of ore reserves. Examination and evaluation of Prospect and mines. Role of Geologist in exploration and mining. Consulting Geologists.	
Unit 3 Exploration Geophysics	
Fundamentals of geophysical prospecting, Methods and Application. Air borne and Ground geophysical surveys, Planning and coordinating geophysical work.	
Unit 4 Exploration Geochemistry	
Principles of geochemical prospecting. Exploration geochemistry sequence, Methods and application. Field and Laboratory analytical methods (Assaying methods.) Treatment of geochemical data.	
Unit 5 Ore Microscopy	
Principles of Ore-Microscopy. Procedures of preparing polished sections, Etching. Scientific and industrial application of ore microscopy. Textures of ore minerals and paragenesis.	
Books suggested for reading:	
<ul style="list-style-type: none"> • Charles, Moon., Michael, Whateley, K.G., and Anthony, M. Evans., 2009, Introduction to Mineral Exploration, 2nd Edition, ISBN: 978-1-444-30912-6 March 2009 Wiley-Blackwell. • Reedman, J. H., Techniques in Mineral Exploration, 1st Edition, ISBN: 978-94-009-9229-0, Springer Dordrecht, XII. • Haldar, S.K. and Elsevier, 2018, Mineral Exploration, Principles and Applications, Second Edition, ISBN 9780128140222. 	

Suggested E-resources

- <https://ibm.gov.in/writereaddata/files/07172017104116Elements%20of%20Mineral%20Exploration.pdf>
- <https://earthresources.vic.gov.au/community-and-land-use/understanding-exploration>
- https://onlinecourses.nptel.ac.in/noc22_ce35/preview

Course learning outcomes

- The expected outcome of the course upon successful completion includes development of ability to apply knowledge based approach for mineral exploration and capacity to judge better use of specific tools for mineral targeting unique to the selected mineral under consideration.

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Code of the course	GEO9008T
Title of the course	Applied Hydrogeology
Credit of the course	4
Level of the course	NHEQF Level 7.0
Type of the course	Discipline Core Course (DCC)
Delivery type of the course	Theory & Lecture
Objectives of the Course	<ul style="list-style-type: none"> To impart applied knowledge of groundwater resources and its occurrence, movement, exploration and management.
Syllabus	
<u>Semester-2 Applied Hydrogeology</u>	
Unit 1 Introduction to Groundwater	
Ground water Geology: Elements of ground water hydrology. Source of ground water and origin. Hydrologic cycle. Occurrence and distribution of ground water. Hydrological properties of water bearing materials. Porosity, Permeability, Transmissibility, Storage coefficient, Specific yield, Specific retention, Laws governing them and methods of their determination.	
Unit 2 Occurrence of Groundwater	
Occurrence of ground water in different types of rocks-igneous, metamorphic and sedimentary (Soluble, Non-soluble and Non-indurated sedimentary).	
Unit 3 Water Table Fluctuations	
Water table; Important causes of fluctuation. Water table and pressure surface maps, methods of their construction and their interpretation. Fresh and Salt water relationship in coastal areas.	
Unit 4 Exploration of Groundwater	
Exploration of ground water by various methods: Geological methods, Hydrological methods, Geophysical methods. Wells –Different types of wells and equipment of their construction. Use of well hydraulics; Well characteristics and their determination.	
Unit 5 Conservation and Management of Groundwater	
Use and conservation of ground water. Artificial recharge of ground water. Basin-wise development of groundwater in Indian subcontinent. Groundwater provinces of India and Rajasthan.	
Books suggested for reading	
<ul style="list-style-type: none"> Alley, W.M., 1993, Regional Groundwater Quality, VNR, New York. Black, W. and Others (ED)., 1989, Hydrogeology. Geol. Soc. Of America Publ. Davies, S.N. and De Wiest, R.J.M., 1966, Hydrogeology, John wiley. Freeze, R. A. and Cherry, J.A., 1979, Groundwater. Prentice Hall Karant, K.R., 1987, Groundwater Assessment – Development and Management. Tata McGraw Hill Raghunath, N.M., 1982: Groundwater. Wiley Eastern Subramaniam, V., 2000, Water. Kingston Publ. London Todd, D.K., 1980, Groundwater Hydrology. John Wiley 	

- Fetter, C.W., 1990, Applied Hydrology

Suggested E-resources

- <https://vidyamitra.inflibnet.ac.in/index.php/search?subject%5B%5D=Geology&course%5B%5D=&domain%5B%5D=Physical+%26+Basic+Sciences>
- <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=8zYwEsyFCoiPyJIPmzHDxg==>

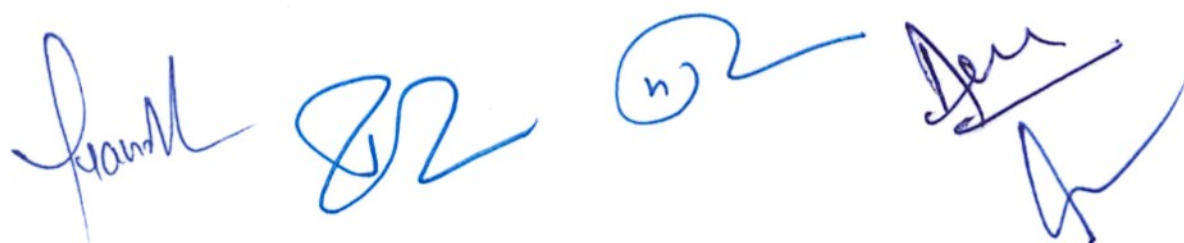
Course learning outcomes

- On successful completion of the course, students will be able to understand the role of groundwater and its occurrence, movement, exploration & management.

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Code of the course	GEO9004P
Title of the course	Applied Hydrogeology and Advanced Mineral Exploration and Mining
Credit of the course	4
Level of the course	NHEQF Level 7.0
Type of the course	Discipline Core Course (DCC)
Delivery type of the course	Practical
Objectives of the Course	<ul style="list-style-type: none"> To give students, practical aspects of the groundwater resource and its management. As per the objectives defined in Advanced Mineral Exploration theory paper with the aim to develop practical skills.
Syllabus	
Semester – 2 Advanced Mineral Exploration and Mining and Applied Hydrogeology	
Applied Hydrogeology	
<ul style="list-style-type: none"> Groundwater Contouring: Preparation of water table contour maps; Calculation of porosity, permeability, yield; Pumping test exercises; Exercises on Graphical representation of chemical quality of groundwater. 	
Advanced Mineral Exploration and Mining	
<ul style="list-style-type: none"> Survey and leveling by Theodolite and related problems. Estimation of ore reserves. Site selection for bore-holes. Basic knowledge and handling of GPS. 	
Viva – Voce Field work Record	
Compulsory Field Training Program: Geological Field Training mainly based on Hydrogeology and Mineral exploration. Note: <u>Compulsory field training program at the end of every semester will be value added part of the practical syllabus which will be of 10 days duration and students opting out of it will loose proportional marks from the practical credit score. The student will have chance to improve the score by doing the field training at his/her own expenses before the commencement of final practical exam and after producing valid certificate from the recognized institute/company duly approved by the field training mentor/ faculty member.</u>	
Books suggested for reading:	
<ul style="list-style-type: none"> Alley, W.M., 1993, Regional Groundwater Quality, VNR, New York. Black, W. and Others (ED)., 1989, Hydrogeology. Geol. Soc. Of America Publ. Davies, S.N. and De Wiest, R.J.M., 1966, Hydrogeology, John wiley. Freeze, R. A. and Cherry, J.A., 1979, Groundwater. Prentice Hall Karanth, K.R., 1987, Groundwater Assessment – Development and Management. 	

<ul style="list-style-type: none"> • Tata, Mc Graw, Hill and Raghunath, H.M., 1982, Groundwater, Wiley Eastern • Subramaniam, V., 2000, Water. Kingston Publ. London • Todd, D.K., 1980, Groundwater Hydrology. John Wiley • Fetter, C.W., 1990, Applied Hydrology 	
Suggested E-resources:	
<ul style="list-style-type: none"> • https://vidyamitra.inflibnet.ac.in/index.php/search?subject%5B%5D=Geology&course%5B%5D=&domain%5B%5D=Physical+%26+Basic+Sciences • https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=8zYwEsfFCoiPyJlPmzHDxg== 	
Course learning outcomes :	
<ul style="list-style-type: none"> • On successful completion of the course, students will be able to understand the role of groundwater and its occurrence movement, exploration and management and also about advance mineral exploration procedure and mining methods. • As per the outcomes defined in Advanced Mineral Exploration theory paper with relevance to practical aspects. 	
EOSE (Practical):	80 Marks
Practical - 45 Marks	
Viva – Voce - 15 Marks	
Record - 20 Marks i. Field Tour Report – 10 Marks ii. Practical Record – 10 Marks	
Internal Exam -	20 Marks
i. Exam - 10 Marks	
ii. Assignment/ Seminar/Quiz – 10 Marks	



Code of the course	GEO9114T
Title of the course	Natural Resource Management
Level of the course	NHEQF Level 7.0
Credit of the course	4
Type of the course	Discipline Specific Elective (DSE)
Delivery type of the course	Theory & Lecture
Objective of the Course:	<ul style="list-style-type: none"> • To understand the natural resources and their significance • To understand the forest resources and policies • To understand the water resources and their management • To understand the land resources and their scientific management • To understand mineral conservation and sustainable development
Syllabus	
<u>Semester-2 Natural Resource Management</u>	
Unit 1 Natural resources	
Definition; Resource and Reserve; Classification of natural resources; natural resource degradation and conservation; Significance of natural resources. Environmental impacts of resource depletion.	
Unit 2 Forest Resources	
Forest cover of India and world; forest types, functions of forest – production and protection; Conservation of forests; forestry programmes – social forestry, farm forestry, urban forestry, community forestry; deforestation; Afforestation; Desertification; Forest policy.	
Unit 3 Water Resources	
Surface, ground water, marine and brackish water resources - assessment and utilization; Rivers and Lakes in India; hydrological cycle; Ground water depletion; Water logging and salinity; Water Conservation and management techniques; Rain water harvesting; Watershed management; Eutrophication; Restoration of Lakes; River cleaning, River action plans - Ganga and Yamuna action plan, Interlinking of rivers; conflicts over water.	
Unit 4 Land resources	
Land degradation due to mining, exploration, industrialization, irrigation and natural disasters; Soil Erosion, Loss of soil fertility, Restoration of soil Fertility, Soil Conservation Methods; restoration of degraded land; Wasteland reclamation, Organic farming, green manuring, Wetland – definition, classification, functions, ecological importance and conservation.	
Unit 5 Mineral resource	
Type of mineral resources, reserve, policy and management. Rock and other building materials. Ocean resources, International territorial policy and geopolitics. Mineral resource management using Geo-spatial technologies. Sustainable Development Goals.	

Books suggested for reading:

- David, A., 2013, Environmental economics and natural resource management, Routledge.
- Singh, Gurdev and Ahuja, Vinod, 1992, Land resource management, Oxford & IBH Pub. Co.
- Peacock, Wilson, Kathy., 2008, Natural resources and sustainable developments, Facts on file Inc.
- Daniel, R. L., 2009, Sustainable natural resource management for scientists and engineers, Cambridge University press
- Jaidev, Somesh, 2010, Natural resources in 21st century, ABD Publisher.
- Panday, S.N. and Misra, S.P. (Eds.), 2008, Essential Environmental Studies, CRC Press.

Suggested E-resources:

- https://www.icar.org.in/content/natural_resource_management_division
- <https://www.india.gov.in/topics/environment-forest/natural-resources>
- <https://www.youtube.com/watch?v=ZFD13WoyUGw>
- <https://indiawris.gov.in/wris>
- <https://fsi.nic.in/>

Course learning outcomes:

- Upon successful completion of this course, the student will be able to integrate and apply technical knowledge in the following key areas
- Appraise the types of natural resources available and their relation with geology
- Invent new ideas to conserve, manage and develop the Earth's natural resources available
- Evaluate the validity and limitations of scientific theories and claims about the environment.
- Appraise the interactions among physical, biological, chemical, and human components of the environment

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Code of the course	GEO9114P	
Title of the course	Natural Resource Management	
Level of the course	NHEQF Level 7.0	
Credit of the course	2	
Type of the course	Discipline Specific Elective (DSE)	
Delivery type of the course	Practical	
Objective of the Course:	<ul style="list-style-type: none"> As per the objectives defined in theory paper with the aim to develop practical skills. 	
Syllabus		
<u>Semester-2 Natural Resource Management</u>		
PRACTICALS		
<ul style="list-style-type: none"> Project work will be allocated to students opting this DSE according to the theory syllabus mentioned for this DSE. 		
Suggested Readings:		
<ul style="list-style-type: none"> David, A., 2013, Environmental economics and natural resource management, Routledge. Singh, Gurdev and Ahuja, Vinod, 1992, Land resource management, Oxford & IBH Pub. Co. Peacock, Wilson, Kathy., 2008, Natural resources and sustainable developments, Facts on file Inc. Daniel, R. L., 2009, Sustainable natural resource management for scientists and engineers, Cambridge University press Jaidev, Somesh, 2010, Natural resources in 21st century, ABD Publisher. Panday, S.N. and Misra, S.P. (Eds.), 2008, Essential Environmental Studies, CRC Press. 		
Suggested E-resources:		
<ul style="list-style-type: none"> https://www.icar.org.in/content/natural_resource_management_division https://www.india.gov.in/topics/environment-forest/natural-resources https://www.youtube.com/watch?v=ZFD13WoyUGw https://indiawris.gov.in/wris https://fsi.nic.in/ 		
Course learning outcomes:		
<ul style="list-style-type: none"> As per the outcomes defined in theory paper with relevance to practical aspects. 		
EOSE (Practical):		80 Marks
Practical	- 45 Marks	
Viva – Voce	- 15 Marks	
Record	- 20 Marks	
Internal Exam -		20 Marks
i. Exam	- 10 Marks	
ii. Assignment/ Seminar/Quiz	- 10 Marks	

Code of the course	GEO9115T
Title of the course	Palaeoceanography & Palaeoclimatology
Level of the course	NHEQF Level 7.0
Credit of the course	4
Type of the course	Discipline Specific Elective (DSE)
Delivery type of the course	Theory & lecture
Objectives of the Course	<ul style="list-style-type: none"> • The objective of this course is to develop an understanding of the field of paleoceanography and paleoclimatology. • The student will develop an understanding about the mechanism of global climate change. • This course will also deliver the insight about the proxies used for paleoceanographic and paleoclimatic studies.
Syllabus	
<u>Semester-2 Palaeoceanography & Palaeoclimatology</u>	
Unit 1 Weather & Climate	
Weather, Climate, Components of climate, Climate classification. Insolation, short and long-term changes in Insolation. Aerosols: Definition, origin, role in climate change. Greenhouse gases: Introduction, causes of changing concentration, role in climate change.	
Unit 2 Ocean	
Origin and evolution of Oceans. Oceanic sediments, Terrigenous, biogenic sediments and their distribution.	
Unit 3 Ocean Climate Linkage	
Sea-level: factors affecting sea-level changes, Short and long-term sea-level variability, evidences of sea-level change from marine sediments. Ocean-climate linkage. Effect of topography/tectonics on climate. Natural variability in climate. Human influence on climate change	
Unit 4 Dating Methods	
Historical evidences of climate change. Effects of climate change on mankind. Sampling methods for retrieving archives of climate/oceanographic change. Various dating methods, merits and demerits of various dating methods.	
Unit 5 Proxies	
Paleoclimatic/paleoceanographic reconstruction from clay, ice, pollens and spores, diatoms, radiolarian, foraminifera, organo-geochemical proxies, corals, speleothems, loess-paleosols. Geomorphologic changes and climate. Elemental and isotopic analysis for paleoclimatic/paleoceanographic reconstruction, Instruments used for paleoclimatic/paleoceanographic studies.	
Books suggested for reading:	

- Bignot, G., 1985, Elements of Micropaleontology, London: Graham and Trotman Ltd.
- Bradley, R.S., Paleoclimatology, Reconstructing Climates of the Quaternary, Academic. Press.
- Brasier, M.D., Allen, Geogrg and Unwin, 1980, Microfossils.
- Cronin, T.M., 1999, Principles of Paleoclimatology, Columbia University Press.
- Fischer, G. and Wefer, G., 1999, Use of Proxies in Paleoceanography, Examples from the South Atlantic, Springer.
- Haq., Boersma and Elsevier., 1978, Introduction to Marine Micropaleontology,
- kennett, J.P., 1982, Marine Geology, Prentice-Hall Inc.
- North, G.R. and Crowley, T.J., 1995, Paleoclimatology, Oxford University Press
- Schopf, T.J.M., 1980, Plaeoceanography, Harvard University Press.
- Tolmazin, D., Allen and Unwin, 1985, Elements of Dynamic Oceanography ,

Suggested E-resources :

- http://ocean.stanford.edu/courses/bomc/chem/lecture_17.pdf
- <https://ocw.mit.edu/courses/12-740-paleoceanography-spring-2008/pages/lecture-notes/>
- <https://www.whoi.edu/sbl/liteSite.do?litesiteid=20812&articleId=53807>
- <http://condor.wesleyan.edu/ethomas/ees123/index.htm>

Course learning outcomes :

- Students will learn about the proxies used for paleoceanographic and paleoclimatic studies
- The students will be able to interpret the paleoceanographic and paleoclimatological data
- The student will also learn about the various sampling techniques used in such studies.

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Code of the course	GEO9114P
Title of the course	Palaeoceanography & Palaeoclimatology
Level of the course	NHEQF Level 7.0
Credit of the course	2
Type of the course	Discipline Specific Elective (DSE)
Delivery type of the course	Practical
Objectives of the Course	<ul style="list-style-type: none"> • As per the objectives defined in theory paper with the aim to develop practical skills.
Syllabus	
<u>Semester-2 Palaeoceanography & Palaeoclimatology</u>	
PRACTICALS	
<ul style="list-style-type: none"> • Exercise on establishing chronology • Interpretation of various types of paleoclimatic and paleoceanographic data • Identification of microfossils used for paleoceanographic and paleoclimatic reconstructions • Sampling techniques used for collecting paleoceanographic and paleoclimatic studies. 	
Books suggested for reading:	
<ul style="list-style-type: none"> • Bignot, G., 1985, Elements of Micropaleontology, London: Graham and Trotman Ltd. • Bradley, R.S., Paleoclimatology, Reconstructing Climates of the Quaternary, Academic. Press. • Brasier, M.D., Allen, George and Unwin, 1980, Microfossils. • Cronin, T.M., 1999, Principles of Paleoclimatology, Columbia University Press. • Fischer, G. and Wefer, G., 1999, Use of Proxies in Paleoceanography, Examples from the South Atlantic, Springer. • Haq., Boersma and Elsevier., 1978, Introduction to Marine Micropaleontology, • Kennett, J.P., 1982, Marine Geology, Prentice-Hall Inc. • North, G.R. and Crowley, T.J., 1995, Paleoclimatology, Oxford University Press • Schopf, T.J.M., 1980, Paleooceanography, Harvard University Press. • Tolmazin, D., Allen and Unwin, 1985, Elements of Dynamic Oceanography , 	
Suggested E-resources :	
<ul style="list-style-type: none"> • http://ocean.stanford.edu/courses/bomc/chem/lecture_17.pdf • https://ocw.mit.edu/courses/12-740-paleoceanography-spring-2008/pages/lecture-notes/ • https://www.whoi.edu/sbl/liteSite.do?litesiteid=20812&articleId=53807 • http://condor.wesleyan.edu/ethomas/ees123/index.htm 	
Course learning outcomes :	
<ul style="list-style-type: none"> • As per the outcomes defined in theory paper with relevance to practical aspects. 	
EOSE (Practical):	
Practical	- 45 Marks
Viva – Voce	- 15 Marks
Record	- 20 Marks
80 Marks	

Internal Exam - i. Exam - 10 Marks ii. Assignment/ Seminar/Quiz - 10 Marks	20 Marks
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Code of the course	GEO9116T
Title of the course	Geoenvironment, Geohazards and Disaster Management
Level of the course	NHEQF Level 7.0
Credit of the course	4
Type of the course	Discipline Specific Elective
Delivery type of the course	Theory & Lecture
Objectives of the Course	<ul style="list-style-type: none"> To impart knowledge of environmental geology, natural hazards their causes and mitigation factors and to prepare students for various competitive national level examinations like Geological Survey of India and CSIR & UGC National Eligibility Test.
Syllabus	
<u>Semester-2 Geoenvironment, Geohazards and Disaster Management</u>	
Unit 1 Introduction to Environmental Geology	
Concepts and scope of Environmental Geology; Earth System Science; The Gaia hypothesis; Global Biogeochemical cycle; Environmental Protection Law	
Unit 2 Environmental Impacts of Mining, Urbanization	
Environmental impacts of urbanization, mining and hydropower projects; water pollution, water logging and soil erosion.	
Unit 3 Geological Investigation to Natural Hazards	
Geological investigations of nuclear waste disposal sites; ozone hole depletion, ocean acidification, coral bleaching, Milankovitch cycle, sea level rise, eutrophication and acid rain	
Unit 4 Causes and Consequences of Natural Hazards: Floods, tsunami and floods	
Natural hazards; Floods, their type and distribution; flood hazard zonation; Mitigation of flood-prone areas; Tsunamis: Causes and distribution; Tsunami-prone zones of India. Volcanoes.	
Unit 5 Causes and Consequences of Natural Hazards: Landslides, Earthquake	
Landslides: their types and controlling factors; Landslide hazard zonation mapping; Earthquakes: Their types and controlling factors, Seismic Zonation map of India.	
Books suggested for reading:	
<ul style="list-style-type: none"> Bryant, E., 1985, Natural Hazards, Cambridge University Press. Bell, F. G., 1999, Geological Hazards. Routledge, London. Keller, E. A., 1978, Environmental Geology, bell and Howell, USA. Patwardhan, A. M., 1999, The Dynamic Earth System. Prentice Hall. Smith, K., 1992, Environmental Hazards. Routledge, London . Subramaniam, V., 2001, Text Book in Environmental Science, Narosa International. Valdiya, K.S., 1987, Environmental Geology – Indian Context, Tata McGraw Hill. 	
Suggested E-resources :	
<ul style="list-style-type: none"> https://epgp.inflibnet.ac.in 	

- e-PG Pathshala - INFLIBNET Centre

- <http://www.oas.org> > dsd > unit CHAPTER 11 - GEOLOGIC HAZARDS

Course learning outcomes :

- The students will be able to understand the interaction of humans with the geological environment. It will lead to having basic knowledge related to occurrence, causes, impact and mitigation of natural hazards. The role of anthropogenic activities on natural environment will be discussed. It will also empower students to compete for various national level examinations like Geological Survey of India and CSIR & UGC National Eligibility Test.

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Code of the course	GEO9116P	
Title of the course	Geoenvironment, Geohazards and Disaster Management	
Level of the course	NHEQF Level 7.0	
Credit of the course	2	
Type of the course	Discipline Specific Elective	
Delivery type of the course	Practical	
Objectives of the Course	<ul style="list-style-type: none"> As per the objectives defined in theory paper with the aim to develop practical skills. 	
Syllabus		
<u>Semester-2 Geoenvironment, Geohazards and Disaster Management</u>		
PRACTICALS		
<ul style="list-style-type: none"> Analysis of different parameters of air, water and noise. Interpretation of air, water and noise data. Preparation of iso- concentration maps of water quality parameters. Seismic maps of World, India and Rajasthan. Exercises on slope failure and landslides. 		
Books suggested for reading:		
<ul style="list-style-type: none"> Bryant, E., 1985, Natural Hazards, Cambridge University Press. Bell, F. G., 1999, Geological Hazards. Routledge, London. Keller, E. A., 1978, Environmental Geology, bell and Howell, USA. Patwardhan, A. M., 1999, The Dynamic Earth System. Prentice Hall. Smith, K., 1992, Environmental Hazards. Routledge, London . Subramaniam, V., 2001, Text Book in Environmental Science, Narosa International. Valdiya, K.S., 1987, Environmental Geology – Indian Context, Tata McGraw Hill. 		
Suggested E-resources :		
<ul style="list-style-type: none"> https://epgp.inflibnet.ac.in e-PG Pathshala - INFLIBNET Centre http://www.oas.org > dsd > unit CHAPTER 11 - GEOLOGIC HAZARDS 		
Course learning outcomes :		
<ul style="list-style-type: none"> As per the outcomes defined in theory paper with relevance to practical aspects. 		
EOSE (Practical):		80 Marks
Practical	- 45 Marks	
Viva – Voce	- 15 Marks	
Record	- 20 Marks	
Internal Exam -		20 Marks
i. Exam	- 10 Marks	
ii. Assignment/ Seminar/Quiz	- 10 Marks	

12/10/2023

Code of the course	GEO9117T
Title of the course	Dissertation
Level of the course	NHEQF Level 7.0
Credit of the course	4
Type of the course	Discipline Specific Elective (DSE)
Delivery type of the course	Special type of Course
Objectives & Outcomes of the Course	<ul style="list-style-type: none"> Independent student will be able to work independently on a geological project.
<ul style="list-style-type: none"> Dissertation can be under any subject teacher on topic related to M.Sc Tech (Applied Geology) and the proposed topic (Applied Geology) and plan will have pre-approval of Mentor and HoD. 	

Code of the course	GEO9117P
Title of the course	Dissertation
Level of the course	NHEQF Level 7.0
Credit of the course	2
Type of the course	Discipline Specific Elective (DSE)
Delivery type of the course	Special type of Course
Objectives & Outcomes of the Course	<ul style="list-style-type: none"> Independent student will be able to work independently on a geological project.
<ul style="list-style-type: none"> Dissertation can be under any subject teacher on topic related to M.Sc Tech (Applied Geology) and the proposed topic (Applied Geology) and plan will have pre-approval of Mentor and HoD. 	

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