

मोहनलाल सुखाड़िया विश्वविद्यालय, उदयपुर
MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR



Syllabus of Geology
for
Three – Year
Under Graduate (B.Sc.) 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 VI Semester B.Sc. with Geology Courses
for Academic Year 2023-26
(Effective for the Academic Year 2023-24)

Faculty of Earth Sciences
Mohanlal Sukhadia University, Udaipur

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List of the Courses in GEOLOGY for the 3 year B.Sc. Program as per NEP 2020

Semester wise Types, Codes, Titles, Delivery type, Workload, Credit of the Courses, Marks of Examination and Remarks if any

Level Sem	Course Type	Course Code	Course Title	Delivery Type			Total Hours	Credit	Total Credit Assessment	Internal Assessment Marks	EoSE Marks	M.M.	Remarks
				L	T	P							
5	I	DCC	GEO5000T	Geology-I: Earth System Science (ESS)	L-3	T-1	-	60	4	20	80	100	
			GEO5000P	Geology Lab-I: Earth System Science (ESS)	-	-	P-8	60	2	20	80	100	
	I	AECC	AEC520XT	Ability Enhancement Course : By University (Hindi)	L-3	T-1	-	30	2	20	80	100	
II	DCC	GEO5001T	Geology-II: Mineral Science	L-3	T-1	-	60	4	20	80	100		
		GEO5001P	Geology Lab-II: Mineral Science	-	-	P-8	60	2	20	80	100		
II	AECC	AEC520XT	Ability Enhancement Course : By University (English)	L-3	T-1	-	30	2	20	80	100	May be opted from other core courses.	
Exit with Certificate in Science (After 4 more credits in SEC)													
6	DCC	GEO6000T	Geology-III: Petrology and Ore Genesis	L-3	T-1	-	60	4	20	80	100		
				GEO6000P	Geology Lab-III: Petrology and Ore Genesis	-	-	P-8	60	2	20	80	100
	SES	SEA630XT	MIL Communication Course: (by University)	L-3	T-1	-	30	2	20	80	100		



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IV	DCC	GEO6001T	Geology-IV: Palaeontology and Stratigraphy	L-3	T-1	-	60	4	6	20	80	100	May be opted from other core courses.
		GEO6001P	Geology Lab-IV: Palaeontology and Stratigraphy	-	-	P-8	60	2		20	80	100	
	SES	SES6350T/ SES6350S	Geological Mapping / Summer Internship	L-3	T-1	-	30	2	2	20	80	100	
Exit with Diploma in Science													
Select anyone of the following Discipline Specific Elective (DSE) Courses in V and VI Semester													
V	DSE	GEO7100T	1. Hydrogeology	L-3	T-1	-	60	4	6	20	80	100	
		GEO7101T	2. Remote Sensing										
		GEO7102T	3. Mineral Exploration and Mining										
	GEO7100P	Elective Geology Lab- 1. Hydrogeology											
	GEO7101P	2. Remote Sensing											
	GEO7102P	3. Mineral Exploration and Mining											
SES	SES7351P /SES7351S	Geoheritage & Geotourism / *Dissertation	L-3	T-1	P-8	30	2	2	20	80	100		
VI	DSE	GEO7103T	1. Structural Geology	L-3	T-1	-	60	4	6	20	80	100	
		GEO7104T	2. Engineering and Environmental Geology										
		GEO7105T	3. Rock, Minerals &										



 Date 10/12/2022



Exit with Graduation Degree in Science (B.Sc.)											
			Water Resources of Rajasthan								
	GEO7103P		Elective Geology. Lab-1 Structural Geology								
	GEO7104P		2 Engineering and Environmental Geology		P-8	2	20	80	100		
	GEO7105P		3. Rock, Minerals & Water Resources of Rajasthan								
	SES7352T/ SES7352S	SEC	GIS & its applications / Summer Internship	L-3	T-1	-	30	2	2	80	100
											May be opted from other core courses.

Information regarding codes:
 The code has eight places. The numbering (digit numbers five six and seven) will be as follows:
 For DCC courses 001 to 099
 For DSE courses 101 to 199
 For AECC courses 201 to 299
 For SEC courses 350 to 359
 If an AECC course is offered by commerce: AEC520JT
 If an AECC course is offered by Science: AES520JT
 If an AECC course is offered by Arts/Humanities/.....: AEA520IT
 The same will the pattern for the SEC courses:
 If an SEC course is offered by commerce: SEC53XXT
 If an SEC course is offered by Science: SES63XXT
 If an SEC course is offered by Arts/Humanities/.....: SEA53XXT

- *Dissertation and Summer Internship reports will be submitted by the candidate for 2 credit calculation under the guidance of a mentor/guide which will be a faculty member, marks of internal on dissertation & summer internship will be given by the mentor/ faculty member. Evolution of dissertation/summer internship reports will be done as per the guidelines of NEP of M.L.S 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%

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B.Sc. (Three Years Degree Program)	
First Semester	
Subject – Geology	
Code of the course	GEO5000T
Title of the course	Geology-I: Earth System Science (ESS)
Qualification Level of the course	NHEQF Level 4.5
Credit for the course	4
Type of the course	Discipline Centric Core Course
Delivery type of the course	Theory
Prerequisites	
Co-requisites	None
Objectives of the Course	<ul style="list-style-type: none"> • This course aims to develop a holistic understanding of the planet Earth and its physical process. • It will also help the student in understanding the processes responsible for the formation of various landforms. • The course will impart a fundamental understanding of hydrogeology and structural geology.
Learning Outcomes	<ul style="list-style-type: none"> • Students are expected to learn about the dynamic planet Earth and the processes responsible for it. • Students will be understanding the exogenic and endogenic processes responsible for the earth's landscape. • Students will also appreciate the role of rock parameters in the field of hydrogeology and structural geology.
Syllabus	
UNIT 1	Introduction to Earth as Planet Holistic understanding of Earth as a dynamic planet. Introduction to various branches of Geology. General characteristics and origin of the Universe, Solar System, and its planets. The terrestrial and jovian planets. Meteorites and Asteroids. Earth in the solar system - origin, size, shape, mass, density, rotational and revolution parameters, and its age. Geological Time Scale.
UNIT 2	Interior and Exterior of Earth's Surface Formation of core, mantle, crust, hydrosphere, atmosphere, and biosphere Convection in Earth's core and production of its magnetic field. The mechanical layering of the Earth. 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. Earthquake and earthquake belts. Volcanoes- types, products, and their distribution.
UNIT 3	Fundamentals of Geomorphology Introduction to Geomorphology. Endogenic and Exogenic processes. Weathering and associated landforms and Hill slopes, Glacial, Periglacial processes and landforms, Fluvial processes and landforms, Aeolian Processes and landforms, and Coastal Processes and



	landforms.
UNIT 4	Fundamentals of Hydrogeology Definition of hydrogeology, Hydrological cycle; Hydrological parameters - Precipitation, evaporation, transpiration, and infiltration. Origin of groundwater; Vertical distribution of groundwater, Types of aquifers; Water bearing properties of rocks - Porosity and Permeability; specific yield, specific retention. Groundwater provinces of India. Groundwater quality.
UNIT 5	Fundamentals of Structural Geology Fundamentals of Structural Geology: Concept of strike and dip. Description and applications of clinometer compass. Primary sedimentary structures: Types of Bedding. Igneous structures. Metamorphic structures: Foliation, Cleavages. Definition and Classification of Fold, Fault, Joint, Lineations, and Unconformity. Description of Stress, Strain, Outliers, Inliers, Overlap and Offlap.
Books suggested for reading	<ol style="list-style-type: none"> 1. Holmes, Arthur., 1992, Principles of Physical Geology, Chapman and Hall, London. 2. Miller., 1949, An Introduction to Physical Geology, East West Press Ltd. 3. Spencer, E.V., 1962, Basic concepts of Physical Geology. Oxford & IBH. 4. Mahapatra, G.B., 1994, A textbook of Physical Geology, CBS Publishers. 5. Press and Siever 1998, Understanding Earth, WH Freeman & Co. 6. Emiliani, C., 1992, Planet Earth: cosmology, geology, and the evolution of life and environment. Cambridge University Press.
Suggested E-resources	<ol style="list-style-type: none"> 1. https://serc.carleton.edu/geo2yc/courses/46478.html 2. https://ocw.mit.edu/courses/12-001-introduction-to-geology-fall-2013/pages/lecture-notes-and-slides/ 3. https://youtube.com/playlist?list=PL0kOtHcPhFRW64YWNXf3H_whgAXGZR4zK 4. https://www.youtube.com/@EarthandSpaceSciencesX 5. https://youtu.be/fiMemypKqEI 6. https://youtu.be/5ieigKikIRY 7. https://youtu.be/3JZb1e_Su3g

B.Sc. (Three Years Degree Program)	
First Semester	
Subject – Geology	
Code of the course	GEO5000P
Title of the course	Geology Lab-I: Earth System Science (ESS)
Qualification Level of the course	NHEQF Level 4.5
Credit for the course	2
Type of the course	Discipline Centric Core Course
Delivery type of the course	Practical
Prerequisites	
Co-requisites	None
Objectives of the Course	<ul style="list-style-type: none"> • The practical exercise aims to develop an understanding of the earth's landscape and tectonic features.
Learning Outcomes	<ul style="list-style-type: none"> • Students will be able to identify various landforms and structural features and understand the mechanism responsible for them.
Syllabus	
	<p>Earth System Science</p> <ul style="list-style-type: none"> • Draw the Physical divisions of India and Rajasthan on respective maps. • Draw the distribution of earthquakes and major mountains on the map of the world and India. • Geological Time Scale • Earth internal structure • Draw landforms of rivers, wind, glaciers, and volcanoes. • Study of physical models showing geomorphic features. • Configuration and Numbering of topographic maps on various scales. • Interpretation of various geomorphic landforms and drainage patterns on toposheet. • Map exercise related to the plotting of major mountain ranges, lakes, and rivers of India & seismic data on the map of India. • Measurement of strike and dip • Identification of structural features in hand specimens
Books suggested for reading	<ol style="list-style-type: none"> 1. Holmes, Arthur., 1992, Principles of Physical Geology, Chapman and Hall, London. 2. Miller., 1949, An Introduction to Physical Geology, East West Press Ltd. 3. Spencer, E.V., 1962, Basic concepts of Physical Geology. Oxford & IBH. 4. Mahapatra, G.B., 1994, A textbook of Physical Geology, CBS Publishers. 5. Press and Siever 1998, Understanding Earth, WH Freeman & Co. 6. Emiliani, C., 1992, Planet Earth: cosmology, geology, and the evolution of life and environment. Cambridge University

	Press.	
Suggested E-resources	<ul style="list-style-type: none"> • https://serc.carleton.edu/geo2yc/courses/46478.html • https://ocw.mit.edu/courses/12-001-introduction-to-geology-fall-2013/pages/lecture-notes-and-slides/ • https://youtube.com/playlist?list=PL0kOtHcPhFRW64YWNXf3H_whgAXGZR4zK • https://www.youtube.com/@EarthandSpaceSciencesX • https://youtu.be/fiMemypKqEI • https://youtu.be/5ieigKikIRY • https://youtu.be/3JZb1e_Su3g 	
EOSE (Practical):		
Practical	- 45 Marks	80 Marks
Viva – Voce	- 15 Marks	
Record	- 20 Marks	
Internal Exam	-	20 Marks
i.	Exam – 10 Marks	
ii.	Assignment/ Seminar/Quiz – 10 Marks	

B.Sc. (Three Years Degree Program)	
Second Semester	
Subject – Geology	
Code of the course	GEO5001T
Title of the course	Geology-II: Mineral Science
Qualification Level of the course	NHEQF Level 4.5
Credit for the course	4
Type of the course	Discipline Centric Core Course
Delivery type of the course	Theory
Prerequisites	
Co-requisites	None
Objectives of the Course	<ul style="list-style-type: none"> • The course intends to introduce the students to general crystallography, crystal structure, properties, and behavior of light. • This course will develop students' knowledge of different rock-forming mineral/ore-forming minerals and perceive their implications as well as comprehension of the optical behavior of minerals/ore minerals
Learning Outcomes	<ul style="list-style-type: none"> • Students will get the idea of a broad overview of both minerals and ore-forming minerals and their application to differentiate between minerals and to imagine the crystals in three dimensions. • Students will be understanding the ore deposits.
Syllabus	
UNIT 1	Fundamentals of Crystallography Crystal-Concept of Crystalline and non-crystalline substances; Interfacial angle and external morphology in relation to internal structures; Crystal parameters and indices; form and zone. Crystal symmetry, classification of crystals into systems. Hermann-Mauguin symbol, Holohedrim, hemihedrim hemimorphism, and enantiomorphism. Study of axial relationship, symmetry elements, and forms present in the different normal classes. Fundamentals of stereographic projection of crystals and their uses. Twinning and Twin Laws: common types of twins and their examples in minerals.
UNIT 2	Fundamentals of Mineralogy Scope of mineralogy. chemical bonding and compound formation. Definition and classification of minerals. Physical properties of minerals; isomorphism and polymorphism. Silicate structure and its classification. Nature of light - wave theory of light, reflection, refraction, polarisation, double refraction. Introduction to the petrological microscope. Optical properties of minerals - isotropic and anisotropic minerals, refractive index and optical indicatrix, pleochroism, and pleochroic scheme; extinction and interference figures.
UNIT 3	Properties of Silicate Minerals Study of atomic structure, chemistry, physical, optical properties, and

	uses of minerals of Olivine, Feldspar, Pyroxene, Amphibole, Garnet, and Mica groups.
UNIT 4	Properties of Metallic Minerals Physical and chemical characteristics, optical properties, and uses of metallic minerals of Lead, Zinc, Copper, and Iron.
UNIT 5	Ore Minerals and Genesis Importance of Crustal evolution in the metallogenesis; Metallogenic epochs and provinces. An overview of various Indian Mineral deposits in cratons and mobile belts. Mineralogy, and genesis of major bauxite, iron ore, and manganese deposits of India. Mineralogy and mode of occurrence of major copper, lead-zinc, and chromite deposits of India.
Books suggested for reading	<ol style="list-style-type: none"> 1. Klein, C., Dutrow, B., Dwight, J. and Klein, C., 2007, The 23rd Edition of the Manual of Mineral 2. Wiley, J. and Sons, Science (after James D. Dana). 3. Kerr, P. F. Hill, Graw, M.C., 1959, Optical Mineralogy. 4. Verma, P. K., 2010, Optical Mineralogy (Four Colour), Ane Books Pvt Ltd. 5. Deer, W. A., Howie, R. A., and Zussman, J., 1992, An introduction to the rock-forming minerals (Vol. 696). London: Longman. 6. Jensen, M. L. and Bateman, A. M., Economic Mineral Deposits, John Wiley & Sons, Singapore
Suggested E-resources	<ol style="list-style-type: none"> 1. https://users.metu.edu.tr/lunel/ 2. https://www.science.smith.edu/geosciences/min_jb/Lecture_Notes.html 3. http://ruby.colorado.edu/~smyth/G30101.html 4. https://www2.tulane.edu/~sanelson/eens211/ 5. https://profiles.uonbi.ac.ke/cnyamai/files/lecture_1-_mineralogy_and_crystallography-3_review.pdf 6. https://ninoval.itu.edu.tr/en/courses/faculty-of-mines/2340/jef-232/ekkaynaklar?g209499 7. https://fac.ksu.edu.sa/sites/default/files/Introduction%20to%20mineralogy.ppt 8. http://academic.brooklyn.cuny.edu/geology/powell/courses/geol17_01/geol17_01.htm 9. https://www.geo.arizona.edu/xtal/geos306/geos306.html 10. https://www.southalabama.edu/geology/haywick/GY302/302-2.pdf 11. https://ocw.mit.edu/courses/12-108-structure-of-earth-materials-fall-2004/pages/lecture-notes/

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B.Sc. (Three Years Degree Program)	
Second Semester	
Subject – Geology	
Code of the course	GEO5001P
Title of the course	Geology Lab-II: Mineral Science
Qualification Level of the course	NHEQF Level 4.5
Credit for the course	2
Type of the course	Discipline Centric Core Course
Delivery type of the course	Practical
Prerequisites	
Co-requisites	None
Objectives of the Course	<ul style="list-style-type: none"> • It includes studying the physical and optical properties of minerals as an integral part of hands-on practical exercises.
Learning Outcomes	<ul style="list-style-type: none"> • After the successful completion of this practical course, the students will be able to identify various rock-forming and ore-forming minerals based on their physical and optical properties.
Syllabus	
	<p>Mineral Science</p> <ol style="list-style-type: none"> 1. Representation of crystal models with respect to axis, symmetry, and forms. 2. Identification and description of rock-forming minerals in hand specimens: Quartz, Feldspar, Muscovite, Biotite, Hornblende, Augite, Olivine, Garnet, Kyanite, Tremolite, Tourmaline, Beryl, Nepheline, Fluorite and Corundum. 3. Microscopic identification of minerals; Olivine, Pyroxene, Garnet, Feldspar, Biotite, Muscovite. Scheme of pleochroism and absorption of a given mineral in thin section. 4. Identification and description of important ore minerals and rocks in hand specimens. Plotting of important economic mineral deposits in the outline map of India.
Books suggested for reading	<ol style="list-style-type: none"> 1. Berry, L.G., Mason, B. and Dietrich, R.V., 1985, Mineralogy: Concepts, Descriptions and determinations, CBS. 2. Dana, E.S. and Ford, W.E., 2002, A textbook of Mineralogy (Reprint). 3. Deer, W.A., Howie, R.A. and Zussman, J., 2013, An Introduction to the rock-forming minerals, ELBS. 4. Gribble, C.D., 2005, Rutley's Elements of Mineralogy, Springer. 5. Kerr, P.F. and Hill, Grew, M.C., 1977, Optical Mineralogy. 6. Nesse, D.W. and Hill, Grew, M.C., 1986, Optical Mineralogy. 7. Perkins, D., 2013, Mineralogy, Prentice Hall. 8. Phillips, F.C., 1971, Introduction to Crystallography, Longman Group Publication. 9. Krishnaswamy S., 1988, India's Mineral Resources, Oxford & IBH Publishing Co. Pvt. Ltd., (Revised by R. K. Sinha) New

	Delhi. 1988.	
Suggested E-resources	<ol style="list-style-type: none"> 1. https://users.metu.edu.tr/lunel/ 2. https://www.science.smith.edu/geosciences/min_jb/Lecture_Notes.html 3. http://ruby.colorado.edu/~smyth/G30101.html 4. https://www2.tulane.edu/~sanelson/eens211/ 5. https://profiles.uonbi.ac.ke/cnyamai/files/lecture_1-_mineralogy_and_crystallography-3_review.pdf 6. https://ninova.itu.edu.tr/en/courses/faculty-of-mines/2340/jef-232/ekkaynaklar?g209499 7. https://fac.ksu.edu.sa/sites/default/files/Introduction%20to%20mineralogy.ppt 8. http://academic.brooklyn.cuny.edu/geology/powell/courses/geo117_01/geo117_01.htm 9. https://www.geo.arizona.edu/xtal/geos306/geos306.html 10. https://www.southalabama.edu/geology/haywick/GY302/302-2.pdf 11. https://ocw.mit.edu/courses/12-108-structure-of-earth-materials-fall-2004/pages/lecture-notes/ 	
EOSE (Practical):		
Practical - 45 Marks		80 Marks
Viva – Voce - 15 Marks		
Record - 20 Marks		
<ol style="list-style-type: none"> i. Field Tour Report – 10 Marks ii. Practical Record – 10 Marks 		
Internal Exam -		20 Marks
<ol style="list-style-type: none"> i. Exam - 10 Marks ii. Assignment/ Seminar/Quiz – 10 Marks 		
Geological Field Training mainly based on General Geology - 06 days duration		

B.Sc. (Three Years Degree Program)	
Third Semester	
Subject – Geology	
Code of the course	GEO6000T
Title of the course	Geology-III: Petrology and Ore Genesis
Qualification Level of the course	NHEQF Level 5.0
Credit for the course	4
Type of the course	Discipline Centric Core Course
Delivery type of the course	Theory
Prerequisites	
Co-requisites	None
Objectives of the Course	<ul style="list-style-type: none"> • To acquire knowledge on different types of rocks, their distinction from each other, and the rock cycle. • To understand the modes of formation of different types of rocks and their origin. • To understand the similarities and differences of the rock types. • To be able to understand how and why different types of mineral deposits are formed. Ore minerals and ore-forming processes.
Learning Outcomes	<ul style="list-style-type: none"> • Understand the fundamentals of sedimentary processes and stratigraphic correlation. • Understand magma generation and evolution, and classification of igneous rocks. • Understand factors of metamorphism, and classify metamorphic rocks. • Understand the basic concept of petrology and understand the formation and types of mineral deposits associated with rocks. • Understand the primary and secondary ore-forming processes.
Syllabus	
UNIT 1	Sedimentary Petrology Petrology: definition and scope. Sediments: origin, transportation, deposition, and lithification. Fabric and texture of sedimentary rocks. Roundness of particles and their geological significance. Major sedimentary structures - primary, secondary, and biogenetic and their significance. Classification of sedimentary rocks. Type of arenites, carbonate rocks, and argillites.
UNIT 2	Igneous Petrology Magma: Definition, origin, chemical composition, and constituents. Crystallization of magma: Bowen's reaction series, magmatic differentiation, and assimilation. Form and structures of extrusive and intrusive igneous rocks. Igneous textures: crystallinity, grain shape, size, and mutual relationship of grains. Classification and types of igneous rocks. Petrogenesis of Important rock types: granite, diorite, syenite, gabbro, rhyolite, basalt, trachyte, and Pegmatite.
UNIT 3	Metamorphic Petrology

	Introduction to Metamorphic rock and its significance. Factors of metamorphism. Classification of Metamorphic rocks. Basic concepts of types of metamorphism, Concepts of isograd and zones of metamorphism. Relationship between metamorphism and deformation. The texture of Metamorphic rocks. Petrogenesis of important metamorphic rocks Quartzite, Marble, Slate, Phyllite, Schist, Gneiss, and Granulite.
UNIT 4	Primary Ore Genesis Processes Magma and its relation with mineral deposits. Elementary ideas of magmatic concentration and hydrothermal process.
UNIT 5	Secondary Ore Genesis Processes Elementary ideas of processes of ore formation by Sedimentation, Volcanogenic, Evaporation, Oxidation and Supergene Enrichment, Metamorphism, Mechanical, and Residual Concentration.
Books suggested for reading	<ul style="list-style-type: none"> • John, D., Winter, Principles of Igneous and Metamorphic petrology. • John, Petti., Sedimentary Rocks. • Hefferan and Brien, O., 2010, Earth materials Wiley-Blackwell. • Tyrell, G.W., The Principle of Petrology. • Jensen, M.L. and Bateman, A.M., Economic Mineral deposits. • Tiwari, S.K., Ore geology, Economic Minerals, and Mineral Economics. • Anthony, Evans, M., Ore geology and Industrial minerals.
Suggested E-resources	<ol style="list-style-type: none"> 1. https://www2.tulane.edu/~sanelson/eens212/index.html 2. http://opengeology.org/textbook/6-metamorphic-rocks/ 3. www.opentextbc.ca/geology/chapter/6-1-clastic-sedimentary-rocks/ 4. www.geology.com 5. www.gsi.gov.in 6. https://egyankosh.ac.in/handle/123456789/66681 7. https://egyankosh.ac.in/handle/123456789/78229 8. https://opengeology.org/petrology/



B.Sc. (Three Years Degree Program)	
Third Semester	
Subject – Geology	
Code of the course	GEO6000P
Title of the course	Geology Lab-III: Petrology and Ore Genesis
Qualification Level of the course	NHEQF Level 5.0
Credit for the course	2
Type of the course	Discipline Centric Core Course
Delivery type of the course	Practical
Prerequisites	
Co-requisites	None
Objectives of the Course	<ul style="list-style-type: none"> • To acquire knowledge on different types of rocks, and their distinction from each other. • To understand the similarities and differences of the rock types. • To be able to identify different types of rocks in the hand specimen as well as under the microscope.
Learning Outcomes	<ul style="list-style-type: none"> • Understand the formation and origin of different types of rocks. • Understand the handling and work process of petrological & ore microscope • Understand the texture and structure of various rock types in hand specimens as well as under the microscope. • Understand the basic concept of petrology and understand the formation and types of mineral deposits associated with rocks.
Syllabus	
	<p>Petrology and Ore Genesis</p> <ol style="list-style-type: none"> 1. Handling of petrological & ore microscope 2. Under a microscope identification of important rocks and ores 3. Identification of some common igneous rocks (Granite, granodiorite, syenite, diorite, anorthosite, norite, gabbro, pyroxenite, peridotite, nepheline syenite, pegmatite, dolerite, basalt, and rhyolite) in hand specimen with particular emphasis on texture and structures. 4. Identification of some common sedimentary rocks (Sandstone, limestone, shale, conglomerate, arkose, grit, greywacke, and breccia.) in hand specimens with particular emphasis on texture and structures. 5. Identification of some common metamorphic rocks (Quartzite, marble, granite gneiss, mica schist, phyllite, slate, amphibolite, charnockite, mylonite, and migmatitic gneiss) in hand specimens with particular emphasis on texture and structures. 6. Identification of some important ore minerals Hematite, Chalcopyrite, Pyrite, Cuprite, Magnetite, Chromite, Arsenopyrite, Galena, Sphalerite, Pyrrhotite, Bauxite,

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	Magnesite, and other important ore minerals (metallic and non-metallic) in hand specimen with particular emphasis on texture and structure.
Books suggested for reading	<ol style="list-style-type: none"> 1. John, D., Winter, Principles of Igneous and Metamorphic petrology, Pearson. 2. Singh, Parbin., Kataria, S. K. and Sons., Engineering & General Geology, New Delhi. 3. John, Petti., Sedimentary Rocks. 4. Paul F. Kerr, Optical Mineralogy 5. Tyrell, G.W., The Principle of Petrology. 6. Shrivastava, J.P., Introduction to Ore microscope. 7. Bernhard, Precejus., The Minerals under the Microscope, An optical guide (ISSN Book 3) Ist Edition.
Suggested E-resources	<ol style="list-style-type: none"> 1. http://www.earth.ox.ac.uk/~oesis/micro/ 2. www.gsi.gov.in 3. https://swayam.gov.in/nd2_cec19_mm02/preview 4. http://opengeology.org/textbook/4-igneous-processes-and-volcanoes/ 5. www.geology.com 6. https://www.virtualmicroscope.org/content/uk-virtual-microscope 7. www.opentextbc.ca/geology/chapter/6-1-clastic-sedimentary-rocks/ 8. https://geographyfieldwork.com/GeologyFieldworkRiskAssesments.htm
EOSE (Practical):	
Practical - 45 Marks	80 Marks
Viva – Voce - 15 Marks	
Record - 20 Marks	
Internal Exam -	20 Marks
<ol style="list-style-type: none"> i. Exam – 10 Marks ii. Assignment/ Seminar/Quiz – 10 Marks 	

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B.Sc. (Three Years Degree Program)	
Fourth Semester	
Subject – Geology	
Code of the course	GEO6001T
Title of the course	Geology-IV: Palaeontology and Stratigraphy
Qualification Level of the course	NHEQF Level 5.0
Credit for the course	4
Type of the course	Discipline Centric Core Course
Delivery type of the course	Theory
Prerequisites	
Co-requisites	None
Objectives of the Course	<ul style="list-style-type: none"> To impart basic knowledge about Geological Time Scale, Stratigraphy, and rocks deposited during different periods. Provide knowledge of rocks deposited in India during different geological periods and life preserved in them. To give knowledge of Palaeobiology and fossils.
Learning Outcomes	<ul style="list-style-type: none"> Understand the basic concept of stratigraphy and paleobiology. Understand the fundamentals of stratigraphy and its branches. Understand the stratigraphy and sedimentation history of different sedimentary basins of India. Understands the Geological time scale and significance of fossils in geological science.
Syllabus	
UNIT 1	Fundamentals of Palaeontology and Stratigraphy Definition of Palaeontology and its relationship with allied subjects. Fossils: Modes of preservation and Uses. Principles of stratigraphy. Stratigraphic classification and correlation. Geomorphologic divisions of India and their stratigraphic features.
UNIT 2	Important Fossils I Morphology and geological distribution of Foraminifera, Graptoloidea, Echinoidea, and Trilobita.
UNIT 3	Important Fossils II Morphology and geological distribution of Gastropoda, Pelecypoda, Cephalopoda, Brachiopoda. Evolutionary history of Man.
UNIT 4	Precambrian Stratigraphy Geological Time Scale and its equivalent formations in India. Stratigraphy of Major Precambrian Protocontinents of India: Dharwar (including Cuddapah and Kurnool), Singhbhum, Bundelkhand (including Vindhyan), Aravalli.
UNIT 5	Phanerozoic Stratigraphy Stratigraphy of Phanerozoic of India: Palaeozoics of Himalayan Terrane, Gondwana (including plant fossils), Siwaliks (including vertebrate fossils), Mesozoic and Cenozoic of Kutch, Spiti, Rajasthan, Trichinopoly and Assam.
Books suggested for	<ul style="list-style-type: none"> Ravindra Kumar: Fundamentals of Historical Geology and

<p>reading</p>	<p>Stratigraphy of India. Willey Eastern New Delhi.</p> <ul style="list-style-type: none"> • Ramakrishnan M. & Vaidyanadhan R., 2010. Geology of India, Vol-I and Vol-II, Geol. Soc. India, Bangalore. • Bharatvarsh Ka Bhu Vigyan: Madhya Pradesh Hindi Granth Academy, Bhopal. • Krishnan M S: Geology of India and Burma, C. B. S. Publication, New Delhi. • Mishra R P 'JeevashmVigyan'. Madhya Pradesh Hindi Granth Academy., Bhopal. • P. C. Jain and M.S. Anantharaman: Palaeontology Evolution and Animal Distribution. Vishal Publications. • Shrock R. P. and Twenhofel W.H.: Principles of Invertebrate Palaeontology. CBS. • Roy A. B. & Jakhar S.R. 2002: Geology of Rajasthan (Northwest India) Precambrian to Recent. Scientific Publishers (India), Jodhpur. • Amal Dasgupta, 2010. Phanerozoic Stratigraphy of India. The World Press Pvt. Ltd. Kolkata. • Roy A.B. & Ritesh Purohit R., 2018. Indian Shield, Precambrian Evolution and Phanerozoic Reconstitution, Elsevier.
<p>Suggested E-resources</p>	<ol style="list-style-type: none"> 1. https://www.youtube.com/watch?v=-S-bhiEDEcc 2. https://www.youtube.com/watch?v=VF5hySdWsKY 3. https://www.youtube.com/watch?v=NQ12RPE7Tpw 4. https://www.youtube.com/watch?v=5ALNHHocXZY&list=PLtmeb20f7jz-Q5YwTpgUefo4N3X9bkiC8 5. https://www.futurelearn.com/courses/extinctions-past-present/19/steps/1312906 6. https://egyankosh.ac.in/bitstream/123456789/69603/1/Block-2.pdf 7. https://en.wikipedia.org/wiki/Geology_of_India 8. https://www.researchgate.net/publication/248552540_Stratigraphic_setting_of_the_Phanerozoic_rocks_along_the_northern_boundary_of_the_Indian_Plate

B.Sc. (Three Years Degree Program)	
Fourth Semester	
Subject – Geology	
Code of the course	GEO6001P
Title of the course	Geology Lab-IV: Palaeontology and Stratigraphy
Qualification Level of the course	NHEQF Level 5.0
Credit for the course	2
Type of the course	Discipline Centric Core Course
Delivery type of the course	Practical
Prerequisites	
Co-requisites	None
Objectives of the Course	<ul style="list-style-type: none"> • To impart basic knowledge about Geological Time Scale, Stratigraphy, and rocks deposited during different periods. • Provide knowledge of rocks deposited in India during different geological periods and life preserved in them. • To give knowledge of Palaeobiology and fossils.
Learning Outcomes	<ul style="list-style-type: none"> • Understand the basic concept of stratigraphy and paleobiology. • Understand the fundamentals of stratigraphy and its branches. • Understand the stratigraphy and sedimentation history of different sedimentary basins of India. Understands the Geological time scale and significance of fossils in geological science.
Syllabus	
	<p>Paleontology</p> <ol style="list-style-type: none"> 1. Identification and description of the following fossils in hand specimens: 2. Foraminifera : Nummulites, Assilina, Alveolina. 3. Echinoidea : Cidaris, Hemiaster, Micraster. 4. Brachiopoda : Rhynchonella, Terebratula, Productus, Spirifer. 5. Pelecypoda : Pecten, Ostrea, Trigonina, Lima, Exogyra. 6. Gastropoda : Trochus, Murex, Voluta, Physa, Turritella, Conus. 7. Ammonoidea : Phylloceras, Ceratites, Perisphinctes. 8. Coleoidea : Belemnites. 9. Nautiloidea : Nautilus, Orthoceras. 10. Trilobita : Calymene, Phacops, Agnostus, Trinucleus, Paradoxides. 11. Graptoloidea : Monograptus, Diplograptus. 12. Plant fossils : Glossopteris, Gangmopteris, Vertibraria, Ptilophyllum. <p>Stratigraphy</p> <ol style="list-style-type: none"> 1. Identification and description of important stratigraphic rocks of India and their assignment to the respective stratigraphic position.

	<p>2. Plotting of the following stratigraphic units and their equivalents in the outline map of India. Delhi-Aravallifold belts, Main Vindhyan Basin, Gondwana Supergroup, Deccan Traps and Siwalik Group.</p> <p>3. Preparation of palaeogeographic maps of Permocarboniferous and Cretaceous periods.</p>
Books suggested for reading	<ul style="list-style-type: none"> • Ravindra Kumar: Fundamentals of Historical Geology and Stratigraphy of India. Willey Eastern New Delhi. • Ramakrishnan M. & Vaidyanadhan R., 2010. Geology of India, Vol-I and Vol-II, Geol. Soc. India, Bangalore. • Bharatvarsh Ka Bhu Vigyan : Madhya Pradesh Hindi Granth Academy, Bhopal. • Krishnan M S: Geology of India and Burma, C. B. S. Publication, New Delhi. • Mishra R P 'Jeevashm Vigyan'. Madhya Pradesh Hindi Granth Academy., Bhopal. • P. C. Jain and M.S. Anantharaman: Palaeontology Evolution and Animal Distribution. Vishal Publications. • Shrock R. P. and Twenhofel W.H.: Principles of Invertebrate Palaeontology. CBS. • Roy A. B. & Jakhar S.R. 2002: Geology of Rajasthan (Northwest India) Precambrian to Recent. Scientific Publishers (India), Jodhpur. • Amal Dasgupta, 2010. Phanerozoic Stratigraphy of India. The World Press Pvt. Ltd. Kolkata. • Roy A.B. & Ritesh Purohit R., 2018. Indian Shield, Precambrian Evolution and Phanerozoic Reconstitution, Elsevier.
Suggested E-resources	<ol style="list-style-type: none"> 1. https://www.youtube.com/watch?v=-S-bhiEDEcc 2. https://www.youtube.com/watch?v=VF5hySdWskY 3. https://www.youtube.com/watch?v=NQI2RPE7Tpw 4. https://www.youtube.com/watch?v=5ALNHhocXZY&list=PLtmeb20f7jz-Q5YwTpgUefo4N3X9bkiC8 5. https://www.futurelearn.com/courses/extinctions-past-present/19/steps/1312906 6. https://egyankosh.ac.in/bitstream/123456789/69603/1/Block-2.pdf 7. https://en.wikipedia.org/wiki/Geology_of_India 8. https://www.researchgate.net/publication/248552540_Stratigraphic_setting_of_the_Phanerozoic_rocks_along_the_northern_boundary_of_the_Indian_Plate
EOSE (Practical):	
Practical	- 45 Marks
Viva – Voce	- 15 Marks
Record	- 20 Marks
i. Field Tour Report	- 10 Marks
ii. Practical Record	- 10 Marks
Internal Exam	-
i. Exam	- 10 Marks
80 Marks	
20 Marks	

ii. Assignment/ Seminar/Quiz – 10 Marks	
Geological Field Training mainly based on Structural Mapping - 06 days duration.	

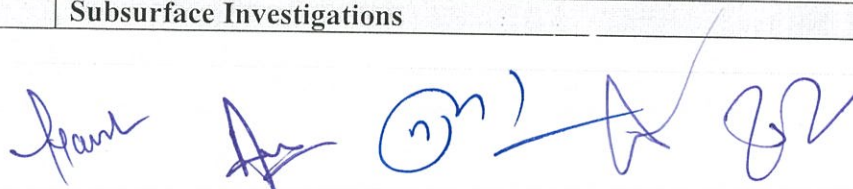
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B.Sc. (Three Years Degree Program)	
Fourth Semester	
Subject – Geology	
Code of the course	SES6350T
Title of the course	Geological Mapping
Qualification Level of the course	NHEQF Level 5.0
Credit for the course	2
Type of the course	Skill Enhancement Course
Delivery type of the course	Theory + Compulsory Field Work
Prerequisites	
Co-requisites	None
Objectives of the Course	<ul style="list-style-type: none"> • The objective of the course is to teach the students how the Earth responds to applied forces. Accurate geometric description of the structures observed in natural deformed rocks. , • Measurement of various orientation data from the structures, plotting them in suitable diagrams, and making a quantitative analysis. • To learn the practice of theoretical knowledge for applying at-ground observation in the field.
Learning Outcomes	<ul style="list-style-type: none"> • At the commencement of this class and field training, students should be able to quantitatively describe the three-dimensional structure of rocks in the earth's crust, using geologic maps and outcrop data, and reconstruct the deformation history of deformed rocks based on fabrics and geometric relationships. • Students will get a brief idea of adaptation to the fieldwork environment in certain professional and scientific organizations. • Students will get knowledge imparted through field trips. • Students are expected to learn different deformational structures.
Syllabus	
UNIT 1	Fundamentals of Geological Mapping Introduction to geological mapping. Types, objectives, and uses of geological mapping: Lithological mapping, Contact Trace Mapping, Structural Mapping, Underground Mapping, Remote Sensing based mapping.
UNIT 2	Mapping Tools and Symbols Introduction to Mapping tools: Clinometer Compass, Brunton Compass, GPS and DGPS, Mapping Apps. Use of surveying and leveling in Mapping. Toposheets: Features and Uses. Symbols used in Geological Maps.
UNIT 3	Types of Geological Maps Concept of contours. Drawing and construction of topographic maps, profile maps and sections, and outcrop maps. V's rule. Knowledge of the Survey of India and Geological Survey of India.

UNIT 4	Structural Features in Mapping Identification and measurement of Linear and planar features: attitude of planar features, Lineations, pitch, plunge, interlimb angle, fault planes, joint planes, etc. Introduction of Stereonet and its uses, S-Pole, Rose diagrams, etc.
UNIT 5	Mapping Techniques and Software Geological Mapping based on GIS software and GPS instrument. Usage of Corel Draw and AutoCAD in geological drawings, Preparation of Mining Plan.
Books suggested for reading	<ol style="list-style-type: none"> 1. Billings, M.P., 2008, Structural Geology, Prentice Hall of India Pvt. Ltd., Delhi, 3rd Edition. 2. Ghosh, S.K., 1993, Structural Geology– Fundamentals and modern development. 3. Park, R.G., 1997, Foundations of Structural Geology, 3rd edition. 4. Ramsay, J.G. and Hill, Grew, M.C., 1967, Folding and fracturing of rocks. 5. Ramsay, J.G. and Huber, M.L., 1987, Modern Structure Geology- Vol. I & II. Academic Pres. 6. Gokhale, N.W., 2001, A Guide to Field Geology, CBS Publishers & Distributors Pvt. Ltd., New Delhi. 7. Kapasya, H.K., 2018, Practical Geology, Himanshu Publication, New Delhi.
Suggested E-resources	<ol style="list-style-type: none"> 1. egyankosh.ac.in 2. http://egyankosh.ac.in/handle/123456789/53276 3. BGYCT-131 Physical and Structural Geology 4. https://egyankosh.ac.in/handle 5. https://epgp.inflibnet.ac.in/epgp_content 6. https://ocw.mit.edu/courses/12-113-structural-geology-fall-2005/pages/lecture-notes

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B.Sc. (Three Years Degree Program)	
Fifth Semester	
Subject – Geology	
Code of the course	GEO7100T
Title of the course	Hydrogeology
Qualification Level of the course	NHEQF Level 5.5
Credit for the course	4
Type of the course	Discipline Specific Elective (DSE)
Delivery type of the course	Theory
Prerequisites	
Co-requisites	None
Objectives of the Course	<ul style="list-style-type: none"> • To impart knowledge about groundwater, its movement, methods of its exploration, the criteria of its quality, methods of its conservation, recharge of groundwater monitoring of groundwater quantity and quality. • To develop an understanding of different components of the hydrological cycle and enable the students to estimate runoff, infiltration, evaporation, and groundwater flow. • The study of this paper strengthens the knowledge of the students with respect to the understanding of the essentials of Groundwater.
Learning Outcomes	<ul style="list-style-type: none"> • On completion of the course, the student will have gained an understanding of hydrogeological concepts, exploration, exploitation, and recharge of groundwater, and methods of monitoring groundwater quality and sources of pollution. • Understand the occurrence of groundwater in varied geological formations. • Understand aquifer properties and groundwater flow equations. • Understand groundwater and surface water interaction, groundwater levels, and environmental influences on it. • Understand the saline water intrusion in coastal aquifers and remedial measures.
Syllabus	
UNIT 1	Fundamentals of Hydrogeology Introduction and basic concepts Scope of hydrogeology and its societal relevance Hydrologic cycle: precipitation, evapotranspiration, run-off, infiltration, and subsurface movement of water. Rock properties affecting groundwater, Vertical distribution of subsurface water Types of the aquifer, aquifer parameters, anisotropy, and heterogeneity of aquifers.
UNIT 2	Groundwater Flow Groundwater flow Darcy's law and its validity Intrinsic permeability and hydraulic conductivity Groundwater flow rates and flow direction Laminar and turbulent groundwater flow.
UNIT 3	Subsurface Investigations



	Well, hydraulics and Groundwater exploration Basic Concepts (drawdown; specific capacity, etc). Surface-based groundwater exploration methods Introduction to subsurface borehole logging methods.
UNIT 4	Groundwater Quality Groundwater chemistry, Physical and chemical properties of water, and water quality Introduction to methods of interpreting groundwater quality data using standard graphical plots Sea water intrusion in coastal aquifers.
UNIT 5	Groundwater Management Groundwater management Surface and subsurface water interaction Groundwater level fluctuations Basic concepts of water balance studies, issues related to groundwater resources development and management Rainwater harvesting and artificial recharge of groundwater.
Books suggested for reading	<ol style="list-style-type: none"> 1. Todd, D. K. 2006. Groundwater hydrology, 2nd Ed., John Wiley & Sons, N.Y. 2. Davis, S. N. and De Weist, R.J.M. 1966. Hydrogeology, John Wiley & Sons Inc., N.Y. 3. Karanth K.R., 1987, Groundwater: Assessment, Development, and Management, Tata McGraw-Hill Pub. Co. Ltd.
Suggested E-resources	<ol style="list-style-type: none"> 1. https://www.geokniga.org/bookfiles/geokniga-hydrogeologyprinciplesandpractice.pdf 2. http://water.lecture.ub.ac.id/files/2012/03/Book_HydrogeologyFieldManual-2ndEdition.pdf 3. https://ocw.mit.edu/courses/1-72-groundwater-hydrology-fall-2005/pages/lecture-notes/


B.Sc. (Three Years Degree Program)	
Fifth Semester	
Subject – Geology	
Code of the course	GEO7101T
Title of the course	Remote Sensing
Qualification Level of the course	NHEQF Level 5.5
Credit for the course	4
Type of the course	Discipline Specific Elective (DSE)
Delivery type of the course	Theory
Prerequisites	
Co-requisites	None
Objectives of the Course	<ul style="list-style-type: none"> • To impart an understanding of the basics of aerial photography and photogrammetry. • To gain knowledge about methods of photogrammetry and air photo interpretation. • To impart an understanding of the fundamentals of remote sensing components. • To gain knowledge about various remote sensing missions.
Learning Outcomes	<ul style="list-style-type: none"> • Understanding of various types of aerial photographs and their scale • Students may able to know errors in aerial photographs and their rectification • Handling and knowledge of mirror and pocket stereoscopes. • Understanding the basic components of Remote Sensing • Students may able to obtain knowledge of the sensor characteristics of various RS Systems • Acquire knowledge of different missions & their utility • Students may be able to understand the functioning, data acquisition, and orbit operations of missions.
Syllabus	
UNIT 1	Fundamentals of Photogeology The elementary idea about photogeology: electromagnetic spectrum, types & geometry of aerial photographs; factors affecting aerial photography; types of camera, film, and filters; factors affecting scale.
UNIT 2	Basics of Remote Sensing Fundamentals of remote sensing; remote sensing systems; remote sensing sensors; signatures of rocks, minerals, and soils. Application of remote sensing in geoscience and geomorphological studies.
UNIT 3	Remote Sensing Satellites Types of Indian and Foreign Remote Sensing Satellites, Digital image processing; fundamental steps in image processing; elements of pattern recognition and image classification.
UNIT 4	GIS functioning GIS, Datum, Coordinate systems and Projection systems Spatial data models and data editing Introduction to DEM analysis.
UNIT 5	GPS functioning



	GPS, Concepts of GPS Integrating GPS data with GIS Applications in earth system sciences.
Books suggested for reading	<ol style="list-style-type: none"> 1. Demers, M.N., 1997. Fundamentals of Geographic Information System, John Wiley & Sons. Inc. 2. Hoffmann-Wellenhof, B., Lichtenegger, H. and Collins, J., 2001. GPS: Theory & Practice, Springer Wien New York. 3. Jensen, J.R., 1996. Introductory Digital Image Processing: A Remote Sensing Perspective, Springer- Verlag. 4. Lillesand, T. M. & Kiefer, R.W., 2007. Remote Sensing and Image Interpretation, Wiley. 5. Richards, J.A. and Jia, X., 1999. Remote Sensing Digital Image Analysis, Springer-Verlag 6. Gupta, R.P., 1990. Remote Sensing Geology. Springer Verlag
Suggested E-resources	<ol style="list-style-type: none"> 1. https://www.iare.ac.in/sites/default/files/lecture_notes/IARE_CE_RS%20and%20GIS_Lecture%20notes.pdf 2. https://nptel.ac.in/courses/105108077 3. https://youtu.be/WbjPPgdmhuQ 4. https://youtu.be/4Rn0M39HOPU

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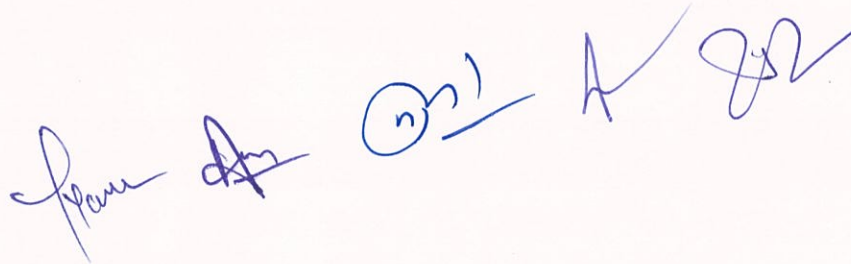
B.Sc. (Three Years Degree Program)	
Fifth Semester	
Subject – Geology	
Code of the course	GEO7102T
Title of the course	Mineral Exploration and Mining
Qualification Level of the course	NHEQF Level 5.5
Credit for the course	4
Type of the course	Discipline Specific Elective (DSE)
Delivery type of the course	Theory
Prerequisites	
Co-requisites	None
Objectives of the Course	<ul style="list-style-type: none"> • This course is designed to enable students to acquire an understanding of the Mineral exploration techniques, acts, and rules governing the mineral sector, and various techniques of mineral exploration, and introduces the basic concept of remote sensing and mining. • To understand the importance of surveying and Levelling in the field of Geology. • To study the basics of linear/angular measurement methods like Tape, chain surveying, compass, and Plane table surveying. • To study the significance of plane table surveying in plan making. • To identify hand specimens of minerals and rocks. • To know the important minerals and rocks of India and their locations. • To understand the site selection for boreholes.
Learning Outcomes	<p>Upon successful completion of the course, the students would be able to get a basic idea to:</p> <ul style="list-style-type: none"> • Calculate angles, distances, and levels by compass and Tape. • Identify data collection methods and prepare field notes. • Estimate measurement errors and apply corrections • Interpret survey data and compute areas and volumes. • Understand the procedures of the plane table and compass survey.
Syllabus	
UNIT 1	Fundamentals of Mineral Exploration Geological techniques and procedures of exploration stages, planning, and operation of exploration. Procedure for obtaining a mining lease.
UNIT 2	Drilling Geological aspects of drilling: drilling methods, selection of sites, angles, and direction of boreholes. Core-logging.
UNIT 3	Sampling Methods of sampling, weighing of samples, and calculation of average grades. Classification of ore reserves, and calculation of cut-off grade. Grade and tonnage. Principles of geochemical and



	geophysical prospecting.
UNIT 4	Mineral Economics Mineral Economics and its concept, tenor, grade, and specifications for important minerals used in industries. Methods of ore reserve estimation. Principles and methods of ore dressing.
UNIT 5	Mining Methods Elements of mining methods: Introduction to open cast and underground mining methods.
Books suggested for reading	<ol style="list-style-type: none"> 1. Arogyaswamy R.N.P.: Courses in Mining Geology, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi. 2. Peters W. C.: Exploration and Mining Geology, John Wiley & Sons, New York. 3. Haldar, S. K.: Mineral Exploration: Principles and Applications. 4. Chouhan T. S.: Encyclopedia of Rajasthan Vol. I, VigyanPrakashan, Jodhpur. 5. Deb, S., 1980: Industrial Minerals and Rocks of India. Allied Publ. New Delhi. pp603. 6. Jensen M. L. & Bateman A. M.: Economic Mineral Deposits, John Wiley & Sons, Singapore 7. Krishnaswamy S.: India's Mineral Resources, Oxford & IBH Publishing Co. Pvt. (Revised by R. K. Sinha) New Delhi.1988, 613 p. 8. Pandey S. N.: Principles and Applications of Photogeology, Wiley Eastern Ltd., New Delhi. 9. Rao T. C. & Gokhle K. V.: Ore Deposits of India: Their Distribution and Processing.
Suggested E-resources	<ol style="list-style-type: none"> 1. https://www.eolss.net/sample-chapters/c05/E6-37-06-08.pdf 2. https://pubs.usgs.gov/of/1995/ofr-95-0831/CHAP3.pdf 3. http://zonge.com/rock-properties-lab/ore-minerals-physical-properties/ 4. https://openei.org/wiki/Magnetotellurics 5. www.surveyofindia.gov.in 6. www.gsi.gov.in 7. https://ibm.go 8. https://www.researchgate.net/publication/301823592_Mining_Methods 9. https://www.princeton.edu/~ota/disk3/1981/8103/810313.PDF

B.Sc. (Three Years Degree Program)	
Fifth Semester	
Subject – Geology	
Code of the course	GEO7100P
Title of the course	Hydrogeology Lab
Qualification Level of the course	NHEQF Level 5.5
Credit for the course	2
Type of the course	Discipline Specific Elective (DSE)
Delivery type of the course	Practical
Prerequisites	
Co-requisites	None
Objectives of the Course	<ul style="list-style-type: none"> • To impart knowledge about groundwater, its movement, methods of its exploration, the criteria of its quality, methods of its conservation, recharge of groundwater monitoring of groundwater quantity and quality. • To develop an understanding of different components of the hydrological cycle and enable the students to estimate runoff, infiltration, evaporation, and groundwater flow. • The study of this paper strengthens the knowledge of the students with respect to the understanding of the essentials of Groundwater.
Learning Outcomes	<ul style="list-style-type: none"> • On completion of the course, the student will have gained an understanding of hydrogeological concepts, exploration, exploitation, and recharge of groundwater, and methods of monitoring groundwater quality and sources of pollution. • Understand the occurrence of groundwater in varied geological formations. • Understand aquifer properties and groundwater flow equations. • Understand groundwater and surface water interaction, groundwater levels, and environmental influences on it. • Understand the saline water intrusion in coastal aquifers and remedial measures.
Syllabus	
	<ol style="list-style-type: none"> 1. Preparation and interpretation of water level contour maps and depth to water level maps Study. 2. preparation and analysis of hydrographs for differing groundwater conditions Water potential zones of India (map study). 3. Graphical representation of chemical quality data and water classification (C-S and Trilinear diagrams). 4. Simple numerical problems related to the determination of permeability in field and laboratory, Groundwater flow, Well hydraulics, etc.
Books suggested for reading	<ol style="list-style-type: none"> 1. Todd, D. K. 2006. Groundwater hydrology, 2nd Ed., John Wiley & Sons, N.Y.

	2. Davis, S. N. and De Weist, R.J.M. 1966. Hydrogeology, John Wiley & Sons Inc., N.Y. 3. Karanth K.R., 1987, Groundwater: Assessment, Development and Management, Tata Mc Graw Hill Pub. Co. Ltd.
Suggested E-resources	1. https://www.geokniga.org/bookfiles/geokniga-hydrogeologyprinciplesandpractice.pdf 2. http://water.lecture.ub.ac.id/files/2012/03/Book_HydrogeologyFieldManual-2ndEdition.pdf 3. https://ocw.mit.edu/courses/1-72-groundwater-hydrology-fall-2005/pages/lecture-notes/
EOSE (Practical):	
Practical - 45 Marks	80 Marks
Viva – Voce - 15 Marks	
Record - 20 Marks	
Internal Exam -	20 Marks
i. Exam – 10 Marks	
ii. Assignment/ Seminar/Quiz – 10 Marks	

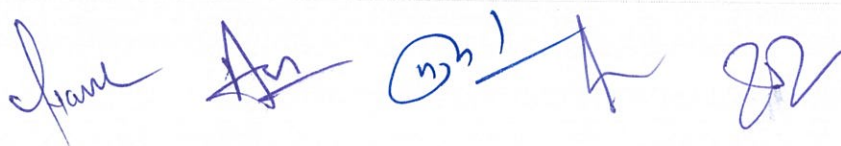


B.Sc. (Three Years Degree Program)	
Fifth Semester	
Subject – Geology	
Code of the course	GEO7101P
Title of the course	Remote Sensing Lab
Qualification Level of the course	NHEQF Level 5.5
Credit for the course	2
Type of the course	Discipline Specific Elective (DSE)
Delivery type of the course	Practical
Prerequisites	
Co-requisites	None
Objectives of the Course	<ul style="list-style-type: none"> • To impart an understanding of the basics of aerial photography and photogrammetry. • To gain knowledge about methods of photogrammetry and air photo interpretation. • To impart an understanding of the fundamentals of remote sensing components. • To gain knowledge about various remote sensing missions.
Learning Outcomes	<ul style="list-style-type: none"> • Understanding of various types of aerial photographs and their scale • Students may able to know errors in aerial photographs and their rectification • Handling and knowledge of mirror and pocket stereoscopes. • Understanding the basic components of remote Sensing • Students may able to obtain knowledge of the sensor characteristics of various RS Systems • Acquire knowledge of different missions & their utility • Students may be able to understand the functioning, data acquisition, and orbit operations of missions.
Syllabus	
	<ol style="list-style-type: none"> 1. Introduction to Aerial photographs and Satellite images- feature identification, Numericals related to the calculation of Scale and Height of Aerial Photographs, Introduction to GIS Software. 2. Digital Image Processing exercises including analysis of satellite data in different bands and interpretation of various objects based on their spectral signatures Creating an FCC from raw data.
Books suggested for reading	<ol style="list-style-type: none"> 1. Demers, M.N., 1997. Fundamentals of Geographic Information System, John Wiley & Sons. Inc. 2. Hoffmann-Wellenhof, B., Lichtenegger, H. and Collins, J., 2001. GPS: Theory & Practice, Springer Wien New York. 3. Jensen, J.R., 1996. Introductory Digital Image Processing: A Remote Sensing Perspective, Springer- Verlag. 4. Lillesand, T. M. & Kiefer, R.W., 2007. Remote Sensing and Image Interpretation, Wiley.

	5. Richards, J.A. and Jia, X., 1999. Remote Sensing Digital image Analysis, Springer-Verlag	
	6. Gupta, R.P., 1990. Remote Sensing Geology. Springer Verlag	
Suggested E-resources	1. https://www.iare.ac.in/sites/default/files/lecture_notes/IARE_CE_RS%20and%20GIS_Lecture%20notes.pdf	
	2. https://nptel.ac.in/courses/105108077	
	3. https://youtu.be/WbjPPgdmhuQ	
	4. https://youtu.be/4Rn0M39HOPU	
EOSE (Practical):		
Practical	- 45 Marks	80 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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B.Sc. (Three Years Degree Program)	
Fifth Semester	
Subject – Geology	
Code of the course	GEO7102P
Title of the course	Mineral Exploration and Mining Lab
Qualification Level of the course	NHEQF Level 5.5
Credit for the course	2
Type of the course	Discipline Specific Elective (DSE)
Delivery type of the course	Practical
Prerequisites	
Co-requisites	None
Objectives of the Course	<ul style="list-style-type: none"> • To understand the importance of surveying and Leveling in the field of Geology. • To study the basics of linear/angular measurement methods like Tape, chain surveying, compass, and Plane table surveying. • To study the significance of plane table surveying in plan making.
Learning Outcomes	<ul style="list-style-type: none"> • Calculate angles, distances, and levels by compass and Tape. • Identify data collection methods and prepare field notes. • Estimate measurement errors and apply corrections • Interpret survey data and compute areas and volumes. • Understand the procedures of the plane table and compass survey.
Syllabus	
	<ol style="list-style-type: none"> 1. Survey: Plain Table surveying. 2. Survey and leveling 3. Ore reserve estimation problems 4. RQD exercise 5. Determination of the angle and direction of a borehole on a profile map.
Books suggested for reading	<ol style="list-style-type: none"> 1. Arogyaswamy R.N.P.: Courses in Mining Geology, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi. 2. Peters W. C.: Exploration and Mining Geology, John Wiley & Sons, New York. 3. Halder, S. K.: Mineral Exploration: Principles and Applications. 4. Chouhan T. S.: Encyclopedia of Rajasthan Vol. I, VigyanPrakashan, Jodhpur. 5. Deb, S., 1980: Industrial Minerals and Rocks of India. Allied Publ. New Delhi. pp603. 6. Jensen M. L. & Bateman A. M.: Economic Mineral Deposits, John Wiley & Sons, Singapore 7. Krishnaswamy S.: India's Mineral Resources, Oxford & IBH Publishing Co. Pvt. (Revised by R. K. Sinha) New Delhi. 1988, 613 p.



	8. Pandey S. N.: Principles and Applications of Photogeology, Wiley Eastern Ltd., New Delhi. 9. Rao T. C. & Gokhle K. V: Ore Deposits of India: Their Distribution and Processing.
Suggested E-resources	1. https://www.eolss.net/sample-chapters/c05/E6-37-06-08.pdf 2. https://pubs.usgs.gov/of/1995/ofr-95-0831/CHAP3.pdf 3. http://zonge.com/rock-properties-lab/ore-minerals-physical-properties/ 4. https://openei.org/wiki/Magnetotellurics 5. www.surveyofindia.gov.in 6. www.gsi.gov.in 7. https://ibm.go 8. https://www.researchgate.net/publication/301823592_Mining_Methods 9. https://www.princeton.edu/~ota/disk3/1981/8103/810313.PDF
EOSE (Practical):	
Practical - 45 Marks	80 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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B.Sc. (Three Years Degree Program)	
Fifth Semester	
Subject – Geology	
Code of the course	SES7351P
Title of the course	Geoheritage and Geotourism
Qualification Level of the course	NHEQF Level 5.5
Credit for the course	2
Type of the course	Skill Enhancement Course
Delivery type of the course	Theory + Compulsory Field Work
Prerequisites	
Co-requisites	None
Objectives of the Course	<ul style="list-style-type: none"> • The course is introduced to impart knowledge of naturally formed typical landforms and Fossils. • It will give knowledge of Geoheritage and its importance in Geotourism.
Learning Outcomes	<ul style="list-style-type: none"> • Students will come to understand Geoheritage, Geodiversity, Geopark, Geotourism, and Geosites for tourists.
Syllabus	
UNIT 1	Fundamentals of Geoheritage Concept, Definition, Features, and Classification of Geoheritage and Geodiversity. Geotourism and its importance. Geodiversity: Its types and geodiversity index. Geoheritage and Geotourism in Relation to Fundamental Geology.
UNIT 2	Geoheritage sites in Rajasthan I UNESCO, National and Rajasthan State level Geoheritage and monumental sites. Geodiversity of Rajasthan. Rock arts in Rajasthan: Sites, Age, technicalities, and messages.
UNIT 3	Geoheritage sites in Rajasthan II Identification of significant geoheritage sites of Rajasthan: Ramgarh Craton, Ancient Mining Site of Zawar, Stromatolites fossils in Aravallis and Vindhyaans, Akali Fossil Park, Usage of various Building stones from Rajasthan in monuments and selected Forts of Rajasthan as well as India.
UNIT 4	Conservation of Geoheritage Conservation of Geoheritage and National geological monuments in Rajasthan. Existing Laws and Policies for Geoheritage Protection. Efforts by the Rajasthan Tourism Department (RTDC) in the preservation of Geoheritagesites. Role of Public awareness programs and Initiatives.
UNIT 5	Geotourism Definition and salient features of Geotourism. The scenario of Geotourism at global and national level. UNESCO Geo-tourism sites and plans. Geotourism scenario in Rajasthan. Important Paleontological Parks, Geoparks in Rajasthan.
Books suggested for reading	<ol style="list-style-type: none"> 1. GEOTOURISM, hotspots of Indian Subcontinent. 2. Murray Gray and Queen Mary, 2004. Geodiversity,

	<p>Geodiversity valuing and conserving abiotic nature. University of London, Edition by John Wiley & Sons Ltd. 228p.</p> <p>3. Reynard and José Brilha, 2017. Geoheritage: Assessment, Protection, and Management., Elsevier, 482p.</p>
Suggested E-resources	<ol style="list-style-type: none"> 1. https://www.egyankosh.ac.in › ...PDF PRECAMBRIAN OF INDIA 2. https://www.rajras.in › geology › Geo-Heritage Sites in Rajasthan National Geological Monuments 3. https://pib.gov.in › printrelease Geo-Heritage Sites 4. https://www.academia.edu › Ancient Mines and Metal Processing Activities in Shekhawati Region of ... 5. http://www.heritageuniversityofkerala.com › ...PDF Ancient Mines and Metal Processing Activities in Shekhawati Region of ... 6. https://pages.ucsd.edu › arch › meta... Ancient Metallurgy. An Overview for College Students 7. http://ancientindianwisdom.com › Ancient Indias Development in Metallurgy 8. https://www.encyclopedia.com › Metallurgy through the Ages 9. kosmosociety.chs.harvard.edu 10. https://www.earthsystems.com › A Brief History of Mining

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B.Sc. (Three Years Degree Program)	
Sixth Semester	
Subject – Geology	
Code of the course	GEO7103T
Title of the course	Structural Geology
Qualification Level of the course	NHEQF Level 5.5
Credit for the course	4
Type of the course	Discipline Specific Elective (DSE)
Delivery type of the course	Theory
Prerequisites	
Co-requisites	None
Objectives of the Course	<ul style="list-style-type: none"> Students come to know about deformation in the earth's crust and knowledge is imparted about structures in rocks like folds, faults, unconformity, joints, cleavages, etc.
Learning Outcomes	<ul style="list-style-type: none"> Students are expected to come out with an in-depth knowledge of different geological structures associated with deformation processes.
Syllabus	
UNIT 1	Primary Structures Bedding: Graded, Cross, and Ripple marks and other primary sedimentary structures to determine the top and bottom of beds. Cleavage, Schistosity, and Foliation Structures. Unconformity and its applications in Structural Geology.
UNIT 2	Secondary Structures Folds: Terminology, Geometry, Classification, Outcrop patterns of plunging and non-plunging folds. Lineations: Types and Genesis, Variations due to folding. Faults: Terminology, geometry, classification, outcrop patterns, and field recognition. Joints: Types and relationship with folds and faults.
UNIT 3	Stress Stress: Concept of stress: normal stress and shear stress components, stress at a point, stress ellipse and stress ellipsoid, principal axes of stress. Special states of stress. Calculation of stress acting on a plane. Mean and deviatoric stress.
UNIT 4	Strain Strain: Concept of strain. Homogeneous and heterogeneous strain. Measurement of strain. Strain ellipse and strain ellipsoid. Finite vs. infinitesimal strain. Pure shear and simple shear deformation. Factors controlling mechanical behavior of rocks.
UNIT 5	Fabric Definition and characteristics of planar and linear fabrics. Description of primary and secondary planar and linear fabrics. Representation of planar and linear fabrics in stereographic projection diagram.
Books suggested for reading	<ul style="list-style-type: none"> Hobbs, B.E., Means, W.D., Williams and John Wiley, 1976, P.F. An outline of structural geology.

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	<ul style="list-style-type: none"> • Ramsay, J.G. and Hill, Graw, M.C., 1967, Folding and fracturing of rocks. • Davis, H., Reynolds, Stephen, J., Kluth, Chuck., Structural geology of rocks and regions /George, 3rd edition. • Park, R.G., 1997, Foundations of Structural Geology, 3rd edition. • Fossen, Haakon., 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., 2008, Structural Geology, Prentice Hall of India Pvt. Ltd., Delhi, 606p, 3rd Edition. • Ramsay, J.G. and Huber, M.L., 1987. Modern Structure Geology- Vol. I & II. Academic Pres.
Suggested E-resources	<ol style="list-style-type: none"> 1. egyankosh.ac.in 2. http://egyankosh.ac.in/handle/123456789/53276 3. BGYCT-131 Physical and Structural Geology 4. https://egyankosh.ac.in/handle 5. https://epgp.inflibnet.ac.in/epgp_content 6. https://ocw.mit.edu/courses/12-113-structural-geology-fall-2005/pages/lecture-notes

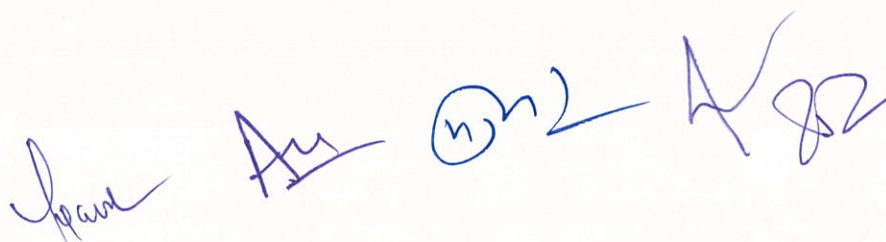
B.Sc. (Three Years Degree Program)	
Sixth Semester	
Subject – Geology	
Code of the course	GEO7104T
Title of the course	Engineering and Environmental Geology
Qualification Level of the course	NHEQF Level 5.5
Credit for the course	4
Type of the course	Discipline Specific Elective (DSE)
Delivery type of the course	Theory
Prerequisites	
Co-requisites	None
Objectives of the Course	<ul style="list-style-type: none"> • To familiarize the students with the scope of Engineering Geology, properties of rocks, selection of reservoir sites, Tunnels and Foundation of geological investigations, and groundwater problems. • To know about the basic concepts of environmental Geology, Causes, effects, strategies for their mitigation, Natural Hazards, and Coastal processes. • To understand Natural disasters, monitoring and disaster management measures for earthquakes, Landslide, Volcanoes, and Tsunamis.
Learning Outcomes	<ul style="list-style-type: none"> • An understanding of the scientific method and how it is used by geologists • Knowledge of the structure and composition of Earth's interior, oceans, and atmosphere • Knowledge of the major types of earth material and explain how each type forms • An understanding of the hydrologic, rock, and tectonic cycles • An understanding of natural hazards and earth resources • An understanding of how earth processes create hazards to life and property • Knowledge of where earth resources occur, how they form, and the major environmental effects of extraction, processing, and use • Knowledge of the major sources of water, soil, and sediment pollution • Knowledge of the major type of natural hazards, and water, soil, and sediment pollution • An understanding of the causes and effects of global climate change.
Syllabus	
UNIT 1	Fundamentals of Engineering Geology Role of Engineering Geologist in planning, design, and construction of major manmade structures. Engineering properties of rocks: crushing strength, porosity, density, abrasive resistance. Concept

	mechanism and significance of rock quality designation (RQD), Rock structure rating (RSR), Rock mass rating (RMR), and Tunnelling Quality Index (Q).
UNIT 2	Applications of Engineering Geology Geological investigation for construction of dams, and tunnels with remedial measures. Building materials - sand, building and dimension stones, aggregates, lime and cement, clays, and clay products. Use of Dolerite, Granite, Gneiss, Marble, Slate, and Sandstone as decorative stones.
UNIT 3	Environmental Geology Definition of ecology and environmental geology, man and environment, scope and importance. Role of Geology in environmental studies. The physical environment - Atmosphere, hydrosphere, lithosphere, and biosphere. Anthropogenic environments.
UNIT 4	Pollution Pollution- air, water, and soil pollution - causes and effects. Heavy metal pollution in groundwater. Greenhouse effect, Global Warming and their effect on the environment. Ozone depletion.
UNIT 5	Geohazards and Disasters Geological hazards: Earthquakes, volcanism, landslides, floods, droughts; Hazard mitigation.
Books suggested for reading	<ol style="list-style-type: none"> 1. Krynin, D.P. and Judd W.R. 1957. Principles of Engineering Geology and Geotechnique, McGraw Hill (CBS Publ). 2. Johnson, R.B. and De Graf, J.V. 1988. Principles of Engineering Geology, John Wiley. 3. Goodman, R.E., 1993. Engineering Geology: Rock in Engineering constructions. John Wiley & Sons, N.Y. 4. Waltham, T., 2009. Foundations of Engineering Geology (3rd Edn.) Taylor & Francis. 5. Bell: F.G-, 2006. Basic Environmental and Engineering Geology 6. Valdiya, K. S., 1987. Environmental Geology - Indian Context. Tata McGraw Hill New Delhi. 7. Keller, E. A., 2000. Environmental Geology. Shales E. Merrill Publishing Co., Columbus, Ohio. 8. Montgomery, C., 1984. Environmental Geology. John Wiley and Sons, London. 8. Bird, Eric, 2000. Coastal Geomorphology: An Introduction. John Wiley & Sons, Ltd. Singapore. 9. Liu, B.C., 1981. Earthquake Risk and Damage, Westview.
Suggested E-resources	<ol style="list-style-type: none"> 1. https://www.aegweb.org/e-eg-journal-nm 2. https://www.researchgate.net/publication/355201938_Engineering_Geology_I_-_Lecture_Notes 3. https://www.pinterest.com/pin/779545016763184623/ 4. https://openlibrary.org/books/OL3949697M/Environmental_geology

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B.Sc. (Three Years Degree Program)	
Sixth Semester	
Subject – Geology	
Code of the course	GEO7105T
Title of the course	Rock, Mineral, and Water Resources of Rajasthan
Qualification Level of the course	NHEQF Level 5.5
Credit for the course	4
Type of the course	Discipline Specific Elective (DSE)
Delivery type of the course	Theory
Prerequisites	
Co-requisites	None
Objectives of the Course	<ul style="list-style-type: none"> • Students learn about rocks related to Rajasthan specifically in terms of stratigraphy and their uses as building and decorative stones. • Students learn about different metallic and non-metallic minerals of Rajasthan and their economic importance in terms of revenue generated. • Students learn about water occurrences in Rajasthan, traditional conservation practices, and future perspectives on water resources in Rajasthan.
Learning Outcomes	<ul style="list-style-type: none"> • Understand groundwater resources and distribution in the NW part of India with specific reference to Rajasthan. • Understand the river flow patterns and preliminary knowledge for constructing dams by citing examples from Rajasthan.
Syllabus	
UNIT 1	Precambrian Rocks of Rajasthan Geology of Rajasthan in connection with its Geomorphologic divisions. Geological Description of Precambrian Rocks of Rajasthan: Banded Gneissic Complex, Aravalli Supergroup, Delhi Supergroups, Sirohi Group, Sindhreth Group, Malani Igneous Suite, Vindhyan Supergroup and Marwar Supergroup.
UNIT 2	Phanerozoic Rocks of Rajasthan Geological description of Phanerozoic Rocks of Rajasthan covering Palaeozoic, Mesozoic, Cenozoic, and Quaternary formations.
UNIT 3	Minerals of Rajasthan Geological description of Important mineral occurrences of Rajasthan: Lead, Zinc, Copper, Gold, Uranium, Iron, Rock Phosphate, Potash, Silica sand, Gypsum, Lignite, China Clay, Gemstones, Petroleum and Natural Gas.
UNIT 4	Stones of Rajasthan Important building and decorative stones of Rajasthan: Jodhpur Sandstone, Makarana and Rajasamand Marble, Kota Sandstone, Chittorgarh and Bundi Limestone, Jaisalmer Limestone, Habur Limestone, Udaipur Green Marble, Jalore Granite, Kishangarh Nepheline Syenite.

UNIT 5	Water Resources of Rajasthan Water resources of Rajasthan. Important Rivers: Mahi, Chambal, Banas, Khari, Parvati, Gomti, Luni, Ghaggar and subsurface Saraswati. Important lakes and Dam Reservoirs: Jaisamand, Rajsamand, Sambhar, Mahi Dam, Gandhisagar Dam, Bisalpur Dam, JawaiBandh, Lakes of Udaipur City, etc. Sub-surface water resources and conservation practices adopted in Rajasthan. Modes of irrigation- major canal system, tube wells, and open wells.
Books suggested for reading	<ul style="list-style-type: none"> • Roy, A. B., &Jakhar, S. R. (2002). Geology of Rajasthan (Northwest India); Precambrian to recent. Scientific Publishers. • Sinha-Roy, S. (2000). Geology of Rajasthan-status and perspective. Geological Society of India. • Todd D. K.: Groundwater Hydrology, John Wiley & Sons, Singapore. • Rajasthan KaBhuvigyan by R. P. Vijayvergiya
Suggested E-resources	<ol style="list-style-type: none"> 1. https://mines.rajasthan.gov.in/ 2. https://www.cswb.gov.in/ 3. http://cgwb.gov.in/Aquifer-Atlas.html 4. https://www.geosocindia.org/index.php/jgsi/article/download/69494/54609 5. https://phedwater.rajasthan.gov.in/content/raj/water/ground-water/en/home.html 6. https://www.rajras.in/water-resources-rajasthan/

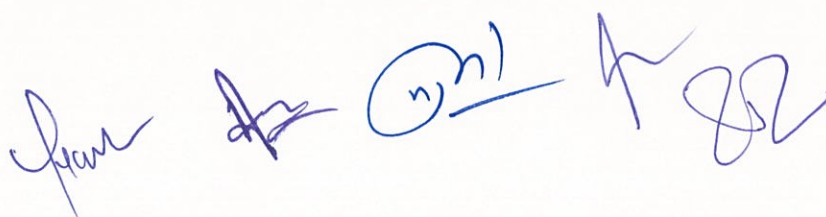


B.Sc. (Three Years Degree Program)	
Sixth Semester	
Subject – Geology	
Code of the course	GEO7103P
Title of the course	Structural Geology Lab
Qualification Level of the course	NHEQF Level 5.5
Credit for the course	2
Type of the course	Discipline Specific Elective (DSE)
Delivery type of the course	Practical
Prerequisites	
Co-requisites	None
Objectives of the Course	<ul style="list-style-type: none"> • Students will learn in practical classes about variations in structure related to primary and secondary deformation.
Learning Outcomes	<ul style="list-style-type: none"> • Students are expected to understand different generations of deformation in relation to various deformation processes.
Syllabus	
	<ol style="list-style-type: none"> 1. Identification of sedimentary, igneous, and metamorphic structures in hand specimens 2. Identification of folds, faults, joints, and lineations in hand specimens. 3. Identification of strained structural specimens in hand specimens. 4. Identification of planar and linear fabric. 5. Stereographic projection and problems. 6. Outcrop map and profile development. 7. Identification of microstructure in thin section.
Books suggested for reading	<ol style="list-style-type: none"> 1. Hobbs, B.E., Means, W.D., Williams and John Wiley, 1976, P.F. An outline of structural geology. 2. Ramsay., J.G. and Hill, Graw, M.C., 1967, Folding and fracturing of rocks. 3. Davis, H., Reynolds, Stephen, J., Kluth, Chuck., Structural geology of rocks and regions /George, 3rd edition. 4. Park, R.G., 1997, Foundations of Structural Geology, 3rd edition. 5. Fossen, Haakon., 2010. Structural Geology. 6. Ghosh, S.K., 1993, Structural Geology–Fundamentals and modern development. 7. Passchier, C.W. and Trouw, R.A.J., 2005, Microtectonics . 8. Billings, M.P., 2008, Structural Geology, Prentice Hall of India Pvt. Ltd., Delhi, 606p, 3rd Edition. 9. Ramsay, J.G. and Huber, M.L., 1987, Modern Structure Geology- Vol. I & II. Academic Pres.
Suggested E-resources	<ol style="list-style-type: none"> 1. egyankosh.ac.in 2. http://egyankosh.ac.in/handle/123456789/53276

	3. BGYCT-131 Physical and Structural Geology 4. https://egyankosh.ac.in › handle 5. https://epgp.inflibnet.ac.in › epgp_content 6. https://ocw.mit.edu/courses/12-113-structural-geology-fall-2005/pages/lecture-notes	
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	
Geological Field Training mainly based on mineral deposits and Stratigraphy units in Rajasthan- 06 days duration.		


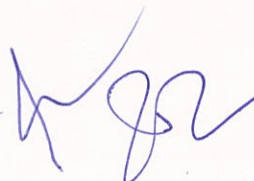
B.Sc. (Three Years Degree Program)	
Sixth Semester	
Subject – Geology	
Code of the course	GEO7104P
Title of the course	Engineering and Environmental Geology Lab
Qualification Level of the course	NHEQF Level 5.5
Credit for the course	2
Type of the course	Discipline Specific Elective (DSE)
Delivery type of the course	Practical
Prerequisites	
Co-requisites	None
Objectives of the Course	<ul style="list-style-type: none"> • To familiarize with the scope of Engineering Geology, properties of rocks, selection of reservoir sites, Tunnels and Foundation of geological investigations, and groundwater problems. • To understand Natural disasters, monitoring and disaster management measures for earthquakes, Landslide, Volcanoes, and Tsunamis.
Learning Outcomes	<ul style="list-style-type: none"> • An understanding of the scientific method and how it is used by geologists • Knowledge of the structure and composition of Earth's interior, oceans, and atmosphere • Knowledge of the major types of earth material and explain how each type forms • An understanding of the hydrologic, rock, and tectonic cycles • An understanding of natural hazards and earth resources • An understanding of how earth processes create hazards to life and property • Knowledge of where earth resources occur, how they form, and the major environmental effects of extraction, processing, and use • Knowledge of the major sources of water, soil, and sediment pollution • Knowledge of the major type of natural hazards, and water, soil, and sediment pollution • An understanding of the causes and effects of global climate change
Syllabus	
	<ol style="list-style-type: none"> 1. Computation of reservoir area, catchment area, reservoir capacity, and reservoir life. 2. Merits, demerits & remedial measures based upon geological cross sections of project sites. 3. Computation of RQD 4. Tracing hazard zoning maps of India – Earthquake, Floods,

	<p>Landslides</p> <p>5. Interpretation of quality of water sample and Air using the given data.</p> <p>6. Analysis of different parameters of air and water.</p>
Books suggested for reading	<ol style="list-style-type: none"> 1. Krynin, D.P. and Judd W.R. 1957. Principles of Engineering Geology and Geotechnique, McGraw Hill (CBS Publ). 2. Johnson, R.B. and De Graf, J.V. 1988. Principles of Engineering Geology, John Wiley. 3. Goodman, R.E., 1993. Engineering Geology: Rock in Engineering constructions. John Wiley & Sons, N.Y. 4. Waltham, T., 2009. Foundations of Engineering Geology (3rd Edn.) Taylor & Francis. 5. Bell: F.G-, 2006. Basic Environmental and Engineering Geology 6. Valdiya, K. S., 1987. Environmental Geology - Indian Context. Tata McGraw Hill New Delhi. 7. Keller, E. A., 2000. Environmental Geology. Shales E. Merril Publishing Co., Columbus, Ohio. 8. Montgomery, C., 1984. Environmental Geology. John Wiley and Sons, London.
Suggested E-resources	<ol style="list-style-type: none"> 1. https://www.aegweb.org/e-eg-journal-nm 2. https://www.researchgate.net/publication/355201938_Engineering_Geology_I_-_Lecture_Notes 3. https://www.pinterest.com/pin/779545016763184623/ 4. https://openlibrary.org/books/OL3949697M/Environmental_geology
EOSE (Practical):	
Practical - 45 Marks	80 Marks
Viva – Voce - 15 Marks	
Record - 20 Marks	
<ol style="list-style-type: none"> i. Field Tour Report – 10 Marks ii. Practical Record – 10 Marks 	
Internal Exam -	20 Marks
<ol style="list-style-type: none"> i. Exam - 10 Marks ii. Assignment/ Seminar/Quiz – 10 Marks 	
Geological Field Training mainly based on mineral deposits and Stratigraphy units in Rajasthan- 06 days duration.	



B.Sc. (Three Years Degree Program)	
Sixth Semester	
Subject – Geology	
Code of the course	GEO7105P
Title of the course	Rock, Mineral, and Water Resources of Rajasthan Lab
Qualification Level of the course	NHEQF Level 5.5
Credit for the course	2
Type of the course	Discipline Specific Elective (DSE)
Delivery type of the course	Practical
Prerequisites	
Co-requisites	None
Objectives of the Course	<ul style="list-style-type: none"> • Students will not only learn about the rock, minerals, and water resources of Rajasthan but also learn about scientific and sustainable use.
Learning Outcomes	<ul style="list-style-type: none"> • Understand groundwater resources and distribution in the NW part of India with specific reference to Rajasthan. • Understand the river flow patterns and preliminary knowledge for constructing dams by citing examples from Rajasthan.
Syllabus	
	<p>Rock, Mineral, and Water Resources of Rajasthan</p> <ol style="list-style-type: none"> 1. Identification of stratigraphic rocks of Rajasthan in hand specimens. 2. Plotting of stratigraphic rocks of Rajasthan in maps of Rajasthan. 3. Identification of economic minerals of Rajasthan in hand specimens. 4. Plotting of economic mineral occurrences in maps of Rajasthan 5. Identification of decorative and building stones of Rajasthan and their plotting on maps of Rajasthan. 6. Water resources and water zone map of Rajasthan. Plotting of gray zones/dark zones/white zones in the map of Rajasthan.
Books suggested for reading	<ol style="list-style-type: none"> 1. Roy, A. B., & Jakhar, S. R. (2002). Geology of Rajasthan (Northwest India); Precambrian to recent. Scientific Publishers. 2. Sinha-Roy, S. (2000). Geology of Rajasthan-status and perspective. Geological Society of India. 3. Todd D. K.: Groundwater Hydrology, John Wiley & Sons, Singapore. 4. Rajasthan Ka Bhuvigyan by R. P. Vijayvergiya
Suggested E-resources	<ol style="list-style-type: none"> 1. https://mines.rajasthan.gov.in/ 2. https://www.cswb.gov.in/ 3. http://cgwb.gov.in/Aquifer-Atlas.html 4. https://www.geosocindia.org/index.php/jgsi/article/download/69494/54609 5. https://phedwater.rajasthan.gov.in/content/raj/water/ground-

	water/en/home.html 6. https://www.rajras.in/water-resources-rajasthan/	
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		
Geological Field Training mainly based on mineral deposits and Stratigraphy units in Rajasthan- 06 days duration.		

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B.Sc. (Three Years Degree Program)	
Sixth Semester	
Subject – Geology	
Code of the course	SES7352T
Title of the course	GIS and its application
Qualification Level of the course	NHEQF Level 5.5
Credit for the course	2
Type of the course	Skill Enhancement Course
Delivery type of the course	Theory + Practical + compulsory Fieldwork
Prerequisites	
Co-requisites	None
Objectives of the Course	<ul style="list-style-type: none"> • This course aims to introduce the students to the fundamental concepts of GIS and GPS. • It will make them familiar with the most essential techniques with hands-on practical experience. • Students will learn about the creation and organization of spatial and non-spatial data. • Students will learn various applications of GIS and GPS.
Learning Outcomes	<p>After successful completion of this course, a student should know</p> <ul style="list-style-type: none"> • Differentiate between different data types in GIS. • Georeference of the spatial data and work on the spatial and nonspatial database • Describe various GIS tools and techniques • Explain the fundamental principles behind GPS technology • Visualize GIS outputs in different dimensions • Create digital GIS maps • Apply spatial data analysis for various applications to deal with natural and environmental problems.
Syllabus	
UNIT 1	Fundamentals of GIS Definition of GIS, History, and development of GIS, Components of GIS, Hardware and Software, GIS operations, Future of GIS
UNIT 2	GIS Data GIS Data Structures: Types (spatial and Non-spatial), Raster, and Vector Data Structure.
UNIT 3	Data Handling Image Processing and Data Analysis: Pre-processing (Radiometric and Geometric Correction), Enhancement (Filtering); Classification (Supervised and Un-supervised), Geo-Referencing; Editing and Output; Overlays.
UNIT 4	GPS and its uses Global Positioning Systems, History, and developments, types of GPS, navigation systems, GPS Surveys, Applications of GPS technology.
UNIT 5	Applications of GIS GIS Applications in various fields of Geology: oil exploration,

	Structural Geology, Hydrogeology, Environmental Geology, Geo-hazards
PRACTICAL	Introduction of GIS, Projection and Reprojection, Georeferencing: Toposheet & Image Registration, Digitization of Toposheet, Map preparation or Map Layout
Books suggested for reading	<ol style="list-style-type: none"> 1. Ahmed, E. L. Rabbany (2002): Introduction to Global Positioning Systems, Artech House, Boston 2. Chang, K. T. (2008): Introduction to Geographic Information Systems, Avenue of the Americas, McGraw-Hill, New York 3. Demers, M. N. (2000): Fundamentals of Geographic Information Systems, John Wiley and Sons, New Delhi 4. Drury, S. A. (2001): Image Interpretation in Geology, Blackwell, Oxford 5. Korte, G. B. (2001): The GIS Book, Onward Press, Bangalore 6. Lillesand, T. M., Kiefer, R. W. and Chipman, J. W. (2008): Remote Sensing and Image Interpretation, John Wiley & Sons, New Delhi 7. Lo, C. P., Yeung, A. W. (2002): Concepts Techniques of Geographical Information Systems, Prentice-Hall of India, New Delhi 8. Longley, P. A., Goodchild, M. F., Maguire, D. J., Rhind, D. W. (2002): Geographical Information Systems and Science, John Wiley & Sons, Chichester 9. Sabins, F. F. (1996): Remote Sensing: Principles and Interpretation, W. H. Freeman and Company, San Francisco
Suggested E-resources	<ol style="list-style-type: none"> 1. https://www.manage.gov.in/studymaterial/gis.pdf 2. https://ocw.mit.edu/courses/11-520-a-workshop-on-geographic-information-systems-fall-2005/pages/lecture-notes/ 3. https://youtu.be/shmMcZ2ZX0k 4. https://youtu.be/oXLIqrbbr0