

M.Sc. APPLIED GEOLOGY AND GEOMATICS

SYLLABUS

(with effect from June 2015)



CENTRE FOR APPLIED GEOLOGY

The Gandhigram Rural Institute – Deemed University
Gandhigram – 624 302 Tamil Nadu

SCHEME OF EXAMINATIONS

FIRST SEMESTER								
Course Code	Paper Title	C	Hours			CFA	ESE	
			L/T	P	E			
15GGMP0101	Physical Geology and Geomorphology	3	3	-	3	40	60	Core Papers
15GGMP0102	Structural Geology, Geotectonics and Palaeontology	4	4	-	3	40	60	
15GGMP0103	Stratigraphy and Indian Geology	4	4	-	3	40	60	
15GGMP0104	Crystallography, Mineralogy and Gemmology	4	4	-	3	40	60	
15GGMP0105	Remote Sensing and GPS	3	3	-	3	40	60	
15GGMP0106	Crystallography and Mineralogy - Practical I	2	-	4	3	60	40	Core Paper – Practicals
15GGMP0107	Structural Geology and Paleontology - Practical II	2	-	4	3	60	40	
15GTPP0001	Gandhi in Everyday Life	2	2	-	-	50	-	CNC
15GGMP01F1	Extension / Field Study / Internship	2	-	-	-	50	-	
Sem. Total Credits		24						

SECOND SEMESTER								
Course Code	Paper Title	C	Hours			CFA	ESE	
			L/T	P	E			
15GGMP0208	Igneous and Metamorphic Petrology	3	3	-	3	40	60	Core Papers
15GGMP0209	Economic Geology, Mineral Economics and Mining Geology	3	3	-	3	40	60	
15GGMP0210	Environmental Geology and Natural Disaster Management	3	3	-	3	40	60	
15GGMP0211	Digital Image Processing and Geocomputing	3	3		3	40	60	
	Non Major Elective	4	4	-	3	40	60	
15GGMP0212	Igneous and Metamorphic Petrology and Economic Geology -Practical III	2	-	4	4	60	40	Core Paper – Practicals
15GGMP0213	Ore Reserve Estimation and Digital Image Processing - Practical IV	2	-	4	4	60	40	
15GGMP02MX	Modular Course	2	2	-	-	50	-	MC
15ENGP00C1	Communication and Soft Skills	-	2	-	-	50	-	CNC
15GGMP02F2	Extension / Field Study / Internship	2	-	-	-	50	-	
Sem. Total Credits		24						

THIRD SEMESTER								
Course Code	Course Title	C	Hours			CFA	ESE	
			L/T	P	E			
15GGMP0314	Sedimentary Petrology and Marine Geology	4	4	-	3	40	60	Core Papers
15GGMP0315	Hydrogeology and Engineering Geology	4	4	-	3	40	60	
15GGMP0316	Petroleum Geology, Coal Geology and Geothermal Resources	4	4	-	3	40	60	
15GGMP0317	Exploration Geophysics and Geochemistry	4	4	-	3	40	60	
15GGMP03EX	Major Elective	4	4	-	3	40	60	
15GGMP0318	Geophysical, Geochemical Survey methods and Hydrogeology -Practical V	2	-	4	4	60	40	Core Paper – Practicals
15GGMP0319	Geographic Information System, and GPS – Practical VI	2	-	4	4	60	40	
15GGMP03MX	Modular Course	2	2	-	-	50	-	MC
15EXNP03V1	Village Placement Programme	2	-	-	-	40	60	CNC
Sem. Total Credits		28						

L/T	-	Lecture / Tutorial Hours	CFA	-	Continuous Formative Assessment
P	-	Practical Hours	ESE	-	End Semester Examination
E	-	Exam Hours	C	-	Credit
CNC	-	Compulsory Non Credit Course	MC	-	Modular Course

FOURTH SEMESTER				
Course Code		CFA	ESE	
15GGMP0420	Dissertation	75	75+50	12
Sem. Total				12

*Evaluation by External Examiner
 **Evaluation by External and Internal Examiner

Major Electives
15GGMP03E1 - Experimental Petrology
15GGMP03E2 - Advanced Ore Geology
15GGMP03E3 - RDBMS, Geographic Information System and Geocomputing

Modular Courses	
15GGMP02M1 – Medical Geology	15GGMP02MX
15GGMP02M2 –Micropaleontology	
15GGMP03M1 - Geostatistics	15GGMP03MX
15GGMP03M2 - Advanced Hydrogeology	

Courses Offered from Centre for Applied Geology							
Course Code	Paper Title	L /T	P	E	CFA	ESE	C
15GEOU04N1	Disaster Management	3	-	3	40	60	3
15GEOU03N1	Applied Geology	3	1	3	40	60	4
15GEOP02N1	Introduction to Geoscience	3	1	3	40	60	4
15GEOP02N2	Medical Geology	3	1	3	40	60	4

15GGMP0101	PHYSICAL GEOLOGY AND GEOMORPHOLOGY	Credit - 3
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Objectives: To understand the Earth's nature and dynamism through Geodynamics. To understand the different surface systems and landform systems and their management through Geomorphology.

Unit	Lecture Content	Lecture Schedule / Hour	Total Lecture Hours / Unit
I.	➤ Geochronology and Age of the Earth – Relative and Absolute Ages – Principles of Isotopic Dating.	1	10
	➤ Types of Decay and Half Life – Brief idea of U-U-Pb, K-Ar, Rb-Sr and Sm-Nd Dating Methods and their significance – Fission Track Dating – Comparative study of Different Dating Methods.	2	
	➤ Problems of interpretation of Dating and Limitations of Isotope Dating.	1	
	➤ Origin and Age of the Universe, The Solar system and the Earth: Various Hypotheses, Concepts and Theories	1	
	➤ Interior of the Earth: Structure and composition	1	
	➤ Earthquakes: Origin and Effects, Causes, Epicenter, Seismograph, Magnitude	2	
	➤ Volcanoes: Types and Causes, Types of Eruption, Diapirism, volcanogenic belts, island arcs.	2	
II.	➤ Climatology : Fundamental principles of Climatology	1	10
	➤ Earth's Radiation Balance: Latitudinal and seasonal variation of insolation, Temperature, Pressure, Wind Belts, Humidity, Cloud Formation and Precipitation, Water Balance	4	
	➤ Paleomagnetism – Paleoclimatic – Paleogeography.	1	
	➤ Koppen's and Thornthwaite's scheme of classification	2	
	➤ Climate Change and Global Warming.	2	
III.	➤ Basic principles of Geomorphology: Classification of landforms - Geomorphic cycle - Davis and Penck's concept.	2	10
	➤ Denudational Geomorphology: Scope of Denudational Geomorphology: Process of weathering - Types of landforms - Resources, Hazards and Environmental Appraisals and Management in Denudational Geomorphic Systems	2	
	➤ Tectonic Geomorphology: Scope of Tectonic Geomorphology - Types of Landforms - Their origin - Resources, Hazards and Environmental Appraisals and Management in Tectono - Geomorphic Systems.	2	
	➤ Fluvial Geomorphology: Streams - definition, scope, drainage classification, morphology and types. Life cycle of river systems – youthful, mature and old stages: migratory behavior of rivers.	2	

	➤ Fluvial landforms: Constructional and destructionallandforms: Resources, hazards and environmental appraisals and management in fluvial systems. Ground water generated landforms: scope–landform types.	2	
IV.	➤ Coastal Geomorphology: Scope of Coastal Geomorphology - Coastal Zone Processes - Classification of Shorelines, - Constructional and Destructional Landforms (Emerging, Submerging, Neutral and Compound). Coasts: -Coastal Landforms - Resources, Hazards and Environmental Appraisals and Management of Coastal Systems.	5	9
	➤ Aeolian Geomorphology: Scope of Aeolian Geomorphology - Processes in Arid Region - Landform Types and Morphology, Aeolian Land Forms - Resources, Hazards and Environmental Appraisals and Management of Aeolian Systems.	4	
V.	➤ Volcanic Geomorphology: Scope of Volcanic Geomorphology - Origin of Volcanoes - Spatial Distribution of Volcanoes around the World – Different Volcanic Landforms - Resources, Hazards and Environmental Appraisals and Management of Volcanic Systems.	4	8
	➤ Bio-genic Landforms: Landform Types, Morphology and their origin.	1	
	➤ Glacial Geomorphology: Landform Types, Morphology and their origin.	1	
	➤ Elementaryconcept of Environmental geomorphology	2	

Specific Outcome of Learning:

At the end of this course the student will be able to,

1. Describe The Orgin and Interior of the Earth, Earthquake and Vocanoes and its causes.
2. Formulate scientific questions about the Geological elements and fundamental aspects of climatology.
3. Identify The Denudational and Fluvial process acting on the surface of the earth and its resultant surface morphology.
4. Describe the coastal process along the shore line on the surface of the earth and its resultant surface morphology.
5. Categorise the volcanic process acting on the surface of the earth and its resultant surface morphology.

Text Book

1. Allen Cox, Plate Tectonics, Freeman and Company, 1973.
2. Radhakrishnan, V, Physical Geology, VV.P. Publishers, 1987.
3. Thornbury, W.D., Principles of Geomorphology, John Wiley and Sons, 2nd Edition, New York. 2002.

Reference Book

1. Bloom, A. Geomorphology. Pearson. Delhi. 2005.
2. Gupta, R.P Remote Sensing Geology, Springer - Verlag - New York, London, 2003.
3. Hamilton, E. I. Applied Geomorphology. Academic Press, 1965.
4. Holmes, A. Principles of Physical Geology. Ronald, 1965.
5. Jha, V.C., Geomorphology and Remote Sensing, ACB Publications. 2001.
6. Sharma, H. S. Indian Geomorphology. Concept Publishing Co., New Delhi, 1990.
7. Thornbury, W. D. Principles of geomorphology, Wiley, 1968.

15GGMP0102	STRUCTURAL GEOLOGY, GEOTECTONICS AND PALEONTOLOGY	Credit - 4
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Objectives: To understand the different geological structures in the earth's crust by explaining knowledge through Structural Geology. To know the past life and history the study of the Earth through remains of animals and plants entombed within the rocks.

Unit	Lecture Content	Lecture Hours	Total Lecture Hours / Unit
I.	➤ Structural Geology: Deformation - Concepts and types of Stress and Strain. Strain Rate, Elastic, Ductile and Brittle Deformation.	2	12
	➤ Mohr's circle, types of stress ellipsoid and their geological significance, strain analyses of naturally deformed rocks.	2	
	➤ Deformation Mechanisms: Stereographic Projections and Stereograms. Cleavage, Foliation, Lineation, Schistosity, Strain Ellipsoid and Crenulation Cleavage.	4	
	➤ Geometry, Types and Mechanism of Folding: Facing Direction of Folds: Cylindrical Folds: Depressions and Culminations, Domes and Saddles, Profile of a Fold.	3	
	➤ Geometry of boudinage structure and its significance	1	
II	➤ Faults: Normal faults, representation of normal faults on the block diagrams.	2	12
	➤ Faults II: Listric faults, reverse faults and thrusts. Stratigraphic differences between normal and reverse faults. Nappe, klippe and tectonic window, flat and steep of the reverse faults, autochthonous and allochthonous units, imbricate and duplex structures, horst and graben.	3	
	➤ Faults III: Strike-slip faults and minor structures associated with such faults: fault rocks: cataclastics and mylonites: Anderson's theory of faulting. Joints: types: genesis: relation to major structures: field data collection and preparation of rose diagrams.	3	
	➤ Types and mechanism of Joints: Graphical Representation of Joints - Joints and Shear fractures – cleavage.	2	
	➤ Foliation and lineation – shear zones – Shear sense indicators.	1	
	➤ Unconformity and Conformable Structures Related to Igneous Intrusion, Diapirs and Salt Domes.	1	
	➤ Lineament Mapping and Analysis - Basin Tectonics. Microstructures and Structures of Sedimentation and Intrusion.	3	13
	➤ Structural analyses: Principle and elements of Structural Analyses. Geometrical Analyses of simple and complex structure on mesoscopic and macroscopic scale.	3	

III	➤ Geotectonics: Continental drift – Plate Tectonics –Elements of Tectonism, Characteristics of Plates, World Plates, Plate Boundaries, Assumptions and Problems, causes and mechanism, Convection, Plate Tectonics and Mineral Deposits.	3	
	➤ Concept of Isostasy, Orogeny & Epiorogeny–Seismic Belts of the Earth – Seismicity and Plate Movements	2	
	➤ Tectonic Frame Work of India.	2	
IV	➤ Fossils and Their Modes of Preservation: Origin and Evolution of life – Recent Theories	3	13
	➤Species concepts –Phylogeny- Antogeny – Palingenesis.	3	
	➤Brief out line of Geological time scale and Life through Ages.	3	
	➤ Invertebrate Paleontology: Morphology - Evolutionary Trends - Stratigraphic importance and application of Trilobites - Graptolites – Corals – Brachiopods - Cephalopods.	4	
V	➤ Vertebrate Paleontology: Classification of Vertebrates –Study of evolution of important vertebrates and their extinctions	3	13
	➤ Palaeobotany: Methods of preservation of fossil plants. Objective and limitation of fossil Plants – Classification	3	
	➤Geological Distribution and Characteristics of Gondwana and Tertiary Flora of India.	3	
	➤ Micropalaeontology: Definition and Applications of Micropalaeontology - Types of Microfossils - Foraminifers and Ostracods – General Morphological Characters - Classification.	4	

Specific outcome of Learning:

The students will be able to

1. Predict the various forces acting in the earths and its resultant structural changes. The Geometry, Types and Mechanism of Folding
2. Describe the resultant movement of rocks, and the resultant Geometry, types and mechanism of Faulting, other minor structures and Joints.
3. Assess the theory of plate tectonics and describe how the outer part of the earth is broken into large fragments (plates) that are constantly in motion relative to each other.
4. Plan ways to systematic study of ancient forms of the life (fossils) and to Evolutionary Principles, and Palaeontologic Techniques.
5. Categorize the vertebrate paleontology and micropaleontology.

Text Book

1. Billings, M. P. Structural Geology, III edition, Prentice-Hall, Inc., New Jersey, USA, 2008.
2. Condie, K.C., Plate Tectonics & Crustal Evolution, Butterworth-Heinemann, Boston, 4th Edition, 2003.
3. Henry Woods, Paleontology Invertebrate, The University Press, 2005

Reference Book

1. David M. Raup & Stanley, M. Stanley, Principles of Paleontology, New Delhi, 2004.
2. Gokhale N W, Theory of structural geology, 2009 .CBS Publications.
3. Hobbs, B. E., Means, W. D., & Williams, P. E. An Outline of Structural Geology, John Wiley & Sons, Inc, Australia 1976.
4. Jain, P.C and Anantharaman, M.S., Paleontology: Evolution and Animal Distribution. (6th edition), Vishal Publishing Co, New Delhi, 2005.
5. Moore, R.C, Lalicker, C.G & Fisher, A.G Invertebrate fossils. (1st Indian edition), CBS Publishers & Distributors, New Delhi, 1997.
6. Park, R.G, Foundation of Structural Geology, Blackie and Sons Ltd., Glasgow, New Zealand, Second edition, 1989.
7. Raup and Stanley, Principles of Paleontology, CBS, 2004.
8. Robert dodd, Robert J St. Antonjor, Paleontology concepts and application, 2nd edition, New Delhi, 2012.
9. Shrock & Twenhofel, Principles of invertebrate paleontology, 2nd edition, New Delhi, 2005.
10. Shrock, R.R and Twenhofel, W.H. Principles of Invertebrate Paleontology. McGraw Hill, New York, 1987

15GGMP0103	STRATIGRAPHY AND INDIAN GEOLOGY	Credit – 4
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Objectives: Stratigraphy is a fundamental part of geology concerning the origin and evolution of the earth understood from different rocks, which were formed during different stages of earth's history.

Unit	Lecture Content	Lecture Hours	Total Lecture Hours / Unit
I.	➤ Stratigraphy: Principles and Classification of Stratigraphy – Lithostratigraphy, Biostratigraphy, Chronostratigraphy, Magneto stratigraphy and its Applications.	3	13
	➤ Chronostratigraphy – An Introduction – Elements of Magnetostratigraphy, Cyclostratigraphy, Allostratigraphy, Pedostratigraphy and Chemostratigraphy. Basic ideas of Sequence stratigraphy and Quaternary Stratigraphy.	3	
	➤Geological Time Scale, Indian Time Scale. ➤Paleogeography and life of each period.	2	
	➤ Correlation: Physical and paleontological correlation.	2	
	➤Homotaxis, Contemporaneity and Syntaxis.	1	
	➤Lateral variation and facies.	1	
	➤Graphic representation of stratigraphic data.	1	
II.	➤ Indian Stratigraphy: Stratigraphic Distribution, Geological Succession, Structure, Tectonics and Economic Importance of	2	12
	➤Archaean system	2	
	➤Dharwar system	2	
	➤Cuddapah system	2	
	➤Kurnool system	2	
	➤Vindhyan system ➤Aravalli system of India.	1 1	
III.	➤Distribution - Classification - Structure - Correlation - Sedimentation - Fossils - Paleogeography and Economic importance of Cambrian to Lower Carboniferous systems	3	13
	➤Gondwana Group,	2	
	➤Triassic of Spiti	3	
	➤Jurassic of Kutch	2	
	➤Cretaceous of Trichinopoly and Pondicherry.	3	
IV.	➤Distribution : Structure, Lithology, Climate, Fossils and Origin of		12
	➤Siwalik system	2	
	➤Pleistocene-Holocene system	2	
	➤Rise of Himalayas - Eocene, Oligocene and Lower Miocene systems.	2	
	➤Deccan Traps: Distribution - Classification - Structure - Geological Succession – Inter-Trappean and Infra-Trappean beds – Origin- Economic importance - Lameta beds - Age and Economic importance.	6	
V.	➤ Boundary and Age Problems:		12

➤Outline about K-T boundary problem,	2	
➤ Precambrian – Cambrian boundary problem	2	
➤Permian Triassic boundary problem.	2	
➤Age problem of the Saline Series.	2	
➤Age problems of deccan traps.	2	
➤ World stratigraphy: Brief description of the principle, stratigraphic units of the world in type area.	2	

Specific outcome of Learning:

At the end of this course the student will be able to,

1. Evaluate the principles of advanced Stratigraphy, and details of Geological Time scale.
2. Identify Indian stratigraphic systems of Archean, Dharwar, Cuddapah, Kurnool, Vindhyan and Aravalli systems.
3. Describe the detailed insight into the Geological Time events of Gondwana, Triassic, Jurassic and Cretaceous.
4. Assess the detailed significance of the Siwalik, Pleistocene, Holocene, Himalayas, and Eocene systems.
5. Analyze the age and boundary problems of various ages.

Text Book

1. Krishnan, M.S., Geology of India and Burma. 6th Edition, CBS Publishers and distributors. 2006.

Reference Book

1. Boggs, S. Principles of Sedimentology and Stratigraphy, Merrill Publishing Co. New York. 1987
2. Ravindra Kumar, Fundamentals of Historical Geology and Stratigraphy of India, New Age International (p) Ltd, 2010.
3. Wadia D, Geology of India, McGraw Hill Book Co. 1975.
4. Weller. A.K. Principles of Stratigraphy. Asia Publishing House. Delhi. 1988
5. Gignoux ,M, Stratigraphical Geology, Mc Graw hill publications, 1960.

15GGMP0104	CRYSTALLOGRAPHY, MINERALOGY AND GEMMOLOGY	Credit-4
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Objectives: Mineralogy is the foundation of petrology. Advanced Mineralogy deals with the aspects of mineralogy related to experimental petrology, crystallographic aspects, mineral analysis, optical aspects and detailed study of mineral groups. The teaching and learning methodology involves theoretical and laboratory demonstrations with mineral specimens and thin sections, crystallographic models, and working out methods of calculating mineral compositions, origin and occurrences.

Unit	Lecture Content	Lecture Hours	Total Lecture Hours / Unit
I.	Crystallography ➤ Definition of Crystal – Classification of crystal into Crystal Systems	2	12
	➤ Concept of Unit Cell – Proper and improper symmetry operations	2	
	➤ Concept of Point Group – Classification of crystals into 32 Point Groups	1	
	➤ Concept of Space lattice – Derivation of 14 Bravais lattices – HCP	1	
	➤ Concept of Space Group – Symmorphic and Asymmorphic Space Groups	2	
	➤ Mineralogical investigations methods -X- ray diffraction,	2	
	➤ Electron Probe Micro Analysis (EPMA), Scanning Electron Microscope (SEM), and Raman Spectroscopy.	2	
II.	Optical Mineralogy ➤ Plane polarized and cross polarized light – Isotropic and Anisotropic minerals, Behaviour of minerals in cross polarized light	2	13
	➤ Birefringence – Uniaxial minerals – Uniaxial and Biaxial Indicatrices – Orientation of indicatrices as per the section	3	
	➤ Interference of light waves – Passage of light through doubly refracting minerals, Generation of interference colours.	3	
	➤ Conoscopic or convergent polarized light – Generation of Uniaxial and Biaxial interference figures – Forms of interference figures related to sections – Optical accessories like mica, gypsum and quartz plates – determination of Optic sign of uniaxial and biaxial minerals.	3	
	➤ Absorption of light by minerals – Scheme of pleochroism	2	
III.	Advanced Mineralogy: ➤ Crystal chemistry- bonding- structures of silicates- Isomorphism, Polymorphism and Pseudomorphism - Atomic Substitution and Solid solution in Minerals - Non Crystalline minerals – Luminescence of Minerals.	5	12
	Descriptive Mineralogy : ➤ Mineral Groups: Chemical, Physical, Optical Properties of minerals. Alteration products, paragenesis and modes of occurrences of the following rock forming silicates:	14	
	➤ Neso silicates: Olivine group	1	

	➤ Garnet group.	1	
	➤ Sorosilicates: Epidote group - Beryl.	1	
IV.	➤ Ring Silicates: Tourmaline –Benitoite.	1	12
	➤ Chain Silicates: Pyroxene group	2	
	➤ Amphibole group and Wollastonite.	1	
V.	➤ Sheet Silicates: Mica group	1	
	➤ Chlorite group	1	
	➤ TectoSilicates: Quartz -Feldspar group	2	
	➤ Feldspathoid group	2	
	➤ Zeolite and Scapolite groups	2	
VI.	➤ Gemmology: Physical characters (including electrical, thermal and magnetic characters) and chemical composition of gemstones:	2	12
	➤ Optical properties.	2	
	➤ Classification of Gemstones.	2	
	➤ Application of UV, X rays and Infra-Red Rays in Gem Identification.	2	
	➤ Synthetic gems – characteristics.	2	
	➤ Uses of gem stones.	2	

Specific outcome of Learning:

At the end of this course the student will be able to,

1. Describe Principles, concepts and methods of advanced crystallography
2. Describe Characteristics of mineralogy and various group of minerals.
3. Categorize silicate structures and group of minerals
4. Assess the Characteristics of Optical mineralogy.
5. Analyse the Gemstone classification and its uses.

Text Book

1. Dana, E.S, A Text Book of Mineralogy, Wiley Eastern, 2006.
2. Berry Mason, L.G, Mineralogy, W.H. Freeman & Co. - 1985.
3. Kerr B.F, Optical Mineralogy. McGraw Hill, 5th Edition, New York, 1995.

Reference Book

1. Deer, W.A., Howie, R.A & Zussman - An Introduction to Rock forming Minerals, Third Edition, ELBS Ed. 2013.
2. Ernest E. Walstrom, Optical Crystallography, John Wiley & Sons. 1979.
3. Perkins, Dexter Mineralogy (3rd Edition) Prentice Hall, 2010.
4. Ravell Phillips, W.M. & Dana.T.Griffen, CBS publishers & Distributors, Optical Mineralogy-The Non- Opaque Minerals, 2004.
5. Mike Howard, Darcy Howard, Introduction to Crystallography and Mineral Crystal Systems, Rock hounding Arkansas, 1998.

15GGMP0105	REMOTE SENSING AND GPS	Credit- 3
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Objective: Remote Sensing and GPS are subjects that utilize laboratory and computer-based manipulation of digital imagery for geological applications such as tectonics, mineral exploration, and others. The student is introduced to the different methods of Remote Sensing and GPS and their field applications with appropriate Indian examples where are necessary.

Unit	Lecture Content	Lecture Hours	Total Lecture Hours / Unit
I.	Remote Sensing – An Introduction	1	9
	➤History and Development of Remote Sensing	1	
	➤Fundamental Principle of Remote Sensing	1	
	➤Stages in Remote Sensing Process	1	
	➤Types of Remote Sensing	1	
	➤Advantages of Remote sensing	1	
	➤Aerial Photograph, Basics, Stereo models, Photo Mosaics and Photo scale	3	
II.	The Electromagnetic Spectrum	3	9
	➤Wave Model		
	➤Particle Theory		
	➤Electromagnetic Spectrum		
	➤Radiation Law and Related Terms		
➤Black Body Radiation	1		
	Electro Magnetic Radiation (EMR): EMR Spectrum –	3	
➤EMR Interaction with Atmosphere: Absorption, Scattering & Atmospheric windows.			
	➤ EMR Interaction with Earth surface.	2	
III.	➤ Satellite and Sensors	1	9
	➤ Platforms		
	➤ Satellite Orbits : Geostationary, Sun-synchronous Satellites		
	Resolution:	1	
	➤Spatial Resolution		
	➤Spectral Resolution		
	➤Radiometric Resolution	1	
➤Temporal Resolution			
➤Multispectral Resolution	1		
➤Scanning Mechanisms	1		
➤Across Track Scanning			
➤Along Track Scanning			
	➤Satellites In Orbits	5	
	➤Landsat Series		
	➤SPOT Series		
	➤Indian Remote Sensing Satellites		
	➤Quickbird Satellite		
	➤World View		
	➤Geo Eye		
	➤Aster		
	➤Modis		
	➤NOAA		

IV.	➤ Photo Interpretation Keys & Elements: Definition, its parts, Key sets, Types of Study.	1	10
	➤ Photo Interpretation Elements - Tone, Texture, Shadow, Size, Shape, Pattern, Association.	2	
	➤Geotechnical / Geomorphic Elements - Landforms, Drainage, Erosional Pattern, Vegetative Cover, Land use, Shape & size of objects.	2	
	➤ Thermal Remote Sensing: Basic concepts and Data Interpretation.	2	
	➤ Microwave Remote Sensing: Basic concepts and Data Interpretation.	2	
	➤ Hyper spectral Remote Sensing: Basic concepts.	1	
V.	➤ GPS Basics: Introduction – Satellite, Control and User Segments – Signal Components	2	9
	➤Errors in GPS observations. ➤GPS positioning.	2	
	➤Differential GPS.	1	
	➤ GPS Mapping: ➤Conventional ➤Static	2	
	➤Kinematic GPS ➤Semi kinematic (Stop & Go) – ➤Rapid static Mobile mapping	2	

Specific outcome of Learning:

At the end of this course the student will be able to,

1. Describe the basic principles of Remote Sensing
2. Describe the Electromagnetic spectrum.
3. Formulate the relationship between electromagnetic radiation, geo objects and the generation of geo information.
4. Categorize insight into different kinds of sensors, systems and satellite platforms.
5. Predict the basic principles of GPS.

Text Book

1. Anji Reddy, M, Textbook of Remote Sensing & GIS, BS Publications, Hyderabad, 2012.
2. Curran, P. Principles of Remote Sensing, Longman, London. 1985.
3. Sabins, F. F. Jr., Remote Sensing Principles and Interpretation, Freeman, Sanfrancisco. 2007.

Reference Book

1. John, T. Smith, Jr, Manual of Colour Aerial Photography (I Edition) American Society of Photogrammetry, ASP Falls Church, Virginia, 1973.
2. Lillesand, T.M. And Kiefer, P.W., Remote Sensing and Image Interpretation, John Wiley & Sons, New York. Third Edition, 2007.
3. Rampal, Handbook of Aerial Photography and Interpretation, Concept publishing. 1999.
4. Shiv N. Pandey, Principles and Applications of Photo geology, Wiley Eastern Limited, India. 1987.

Objectives: *This practical introduces the student to the methods of crystallography, mineralogy and Paleontology. The teaching and learning methodology involves practical and laboratory demonstrations with aid of mineral specimens and thin sections, crystallographic models, mineral specimens and working out methods of calculating mineral compositions and others.*

1. Crystal models of type minerals in each class of systems.
2. Crystal Projections, Stereographic projections and calculation of crystal elements.
3. Equation of normal, axial ratios, interfacial angles, indices of faces.
4. Weiss zone of law, rule of three faces in zone.
5. Derivation of Millerian signs for a cozoal quartette.
6. Determination of Optical Properties of Minerals using Petrological Microscope.
7. Relative birefringence, order of interference colour, sign of elongation, birefringence, scheme of pleochroism and pleochroic formula.
8. Optic orientation, extinction angle, anorthite content.
9. Mineral Calculation. - garnet, olivine, pyroxene, feldspar, mica, Amphibole.
10. Megascopic Identification of Rock Forming Minerals.

Specific outcome of Learning: *The student gains an understanding of the methods of crystallography, mineralogy and mineral calculation is useful for routine laboratory work.*

15GGMP0107	PALAEOLOGY AND STRUCTURAL GEOLOGY - PRACTICAL II	Credit-2
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Objectives: *This practical introduces the student to the methods of advanced structural geology and Palaeontology. The teaching and learning methodology involves practical and laboratory demonstrations with aid of fossils and working out methods of calculating age and structural components.*

1. Megascopic identification of Fossils.
2. Reconstruction of Broken Fossils.
3. Tracing Evolutionary trends in Mega Fossils.
4. Chronological Arrangement of Megafossils.
5. Identification of Microfossils.
6. Three point problems for Fold maps, Fault maps, and Unconformity maps
7. Preparation of cross sections across the geological maps to bring out the structure and order of superposition of the beds.
8. Structural geology problems/Graphical determination of Dip in gradient.
9. Determination of True dip by simple calculation.
10. Determination of Apparent dips by Graphical method.
11. Determination of Thickness of bed by calculation on a level ground.
12. Geometric analyses of linear and planar features.
13. Visual Interpretation Methods
14. Satellite Image interpretation - Structural / geomorphological / Landuse land cover.

Specific outcome of Learning: *The student gains an understanding of the methods of working out and solving problems in structural geology fossil and microfossils identification which may be useful for job prospects related to mineral and oil exploration industries.*

15GGMP0208	IGNEOUS AND METAMORPHIC PETROLOGY	Credit-3
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Objectives: Petrology is the study of rocks. It involves field geology, megascopic and thin section studies along with experimental petrology. The teaching and learning methodology involves class lectures, practical and laboratory demonstrations.

Unit	Lecture Content	Lecture Hours	Total Lecture Hours / Unit
I	➤ Igneous Petrology: Composition and Constitution of Magmas – Phase rule	2	11
	➤ Reaction principles in petrogenesis – continuous and discontinuous series.	1	
	➤ Crystallization of Unicomponent Magma, Bicomponent Magma (Diopside - Anorthite, Forsterite – Silica and Albite - Anorthite).	2	
	➤ Ternary Magma (Albite - Anorthite - Diopside, Forsterite - Anorthite-Silica, Diopside – Forsterite -Anorthite).	3	
	➤ Outline of Quaternary System for Basalt.	1	
	➤ Magmatic Crystallization, Differentiation-Assimilation.	1	
	➤ Bowen’s Reaction Principle - Crystallisation of Basaltic Magma.	1	
II	➤ Classification of Igneous rocks – Chemical classification	1	10
	➤ CIPW Norm- Silica saturation- Alumina saturation.	2	
	➤ Tyrrell’s tabular Classification. IUGS classifications.	2	
	➤ Types of Variation diagrams and their utility	1	
	➤ A detailed Petrography of Acid, Intermediate Igneous rocks	2	
	➤ A detailed Petrography of Basic and Ultra basic Igneous Rocks and their volcanic equivalents.	2	
III	➤ Petrography of Anorthosites, Pegmatites	2	8
	➤ Petrography of Carbonatites	1	
	➤ Petrography of Lamprophyres, Granites	2	
	➤ Petrography of Kimberlite.	1	
	➤ Igneous rocks at Continental margins: The Ophiolite suite	1	
	➤ Cal alkaline and Tholeiite group of rocks	1	
	➤ Metamorphic Petrology: Definition, Kinds, Agents and Minerals of Metamorphism.	1	
IV	➤ Laws of Thermodynamics, Gibbs free energy. Concept of Activity, Fugacity, Ideal and Non-Ideal solutions.	2	9
	➤ Geothermobarometry.	1	
	➤ Classification, Nomenclature, Metamorphic textures and Microstructures	2	
	➤ Mineralogical phase rule of close and open system.	1	
	➤ Mineral assemblages, metamorphic reactions	1	
	➤ P-T conditions of metamorphism.	1	
	➤ Metamorphic Grades and Facies.	1	
	➤ ACF, AKF, ACM diagrams.	2	7

V	➤Metamorphism vs Metasomatism Metamorphic differentiation	1	
	➤Petrography, nomenclature, classification and petrogenesis of the following rocks: Slates – Phyllites – Schists – Gneisses – Granulites - Charnockites – Eclogites – Amphibolites – Khondalites – Migmatites.	2	
	➤Remote Sensing based mapping of Igneous, Sedimentary and Metamorphic rocks.	1	

Specific outcome of Learning:

At the end of this course the student will be able to,

1. Describe the Magmatic process and formation of igneous rocks.
2. Categorize the different types of Igneous Rocks
3. Describe the Rock formations and important rock descriptions.
4. Evaluate the Environment of deposition and also Metamorphic Petrology.
5. Assess the Petrography, nomenclature, classification and petrogenesis of important metamorphic rocks.

Text Book

1. Sengupta, S. Introduction to Sedimentology, CBS Publishers and Distributors, 2011.
2. Turner, F.J. and Verhoogen, J., Igneous and Metamorphic Petrology – CBS publishers. 2002.
3. Pettijohn, F.J., Sedimentary Rocks, Harper & Row, New York, 3rd Edition, 1975.

Reference Book

1. Best, M. G., Igneous and Metamorphic Petrology. Wiley. New Delhi. 2003
2. Best, M. G., Igneous Petrology. Wiley, New Delhi. 2005
3. Bowen, N.L., Evolution of Igneous Rocks, 1928
4. Collision, J.D. & Thompson, D.B. Sedimentary Structures. 2nd Ed. Unwin Hyman, London, 1989.
5. Donald W. Hyndman, Petrology of Igneous and Metamorphic Rocks, McGraw Hill Book co, 1985.
6. Ernest G. Ehlers, Harvey Blatt, Petrology Igneous Sedimentary and Metamorphic, 3rd Edition, 2005.
7. Hota, R.N., Practical Approach to Petrology. CBS, New Delhi. 2011
8. Philipotts, An Igneous and Metamorphic Petrology, Prentice Hall, 1992.
9. Reineck, H.E., and Singh I.B. Depositional Sedimentary Environments, Springer Verlag, 1980.
10. Wernest G. Ehlers and Harvey Blatt, Igneous, Sedimentary and Metamorphic Rocks, CBS Publishers and Distributors, New Delhi, 1999.
11. Winter, J. D., Principles of Igneous and Metamorphic Petrology. PHI. New Delhi. 2010

15GGMP0209	ECONOMIC GEOLOGY, MINERAL ECONOMICS AND MINING GEOLOGY	Credit- 3
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Objectives: *Economic Geology is the study of mineral deposits. It complements the methods of geological exploration, mining geology, and different end uses of minerals.*

Unit	Lecture Content	Lecture Hours	Total Lecture Hours / Unit
I	Process of Ore Formation:	1	9
	➤ Process of Formation of Ore Deposits.	1	
	➤ Classification: Magmatic Concentration, Sublimation	1	
	➤ Contact Metasomatism, Hydrothermal Process	2	
	➤ Sedimentation, Evaporation, Residual and Mechanical concentration	1	
	➤ Oxidation and Supergene Enrichment and Metamorphism.	1	
	➤ Controls and Localization of Mineral Deposits.	1	
	➤ Metallogenic Epochs and Provinces.	1	
II	Study of important Metallic Minerals:	2	9
	Study of following Metallic Mineral Deposits, their Origin, Occurrence & Distribution in India and Uses. Gold, Silver, Platinum	1	
	➤ Aluminum, Iron	1	
	➤ Manganese, Chromium	1	
	➤ Vanadium, Molybdenum	1	
	➤ Tungsten, Nickel	1	
	➤ Cobalt, Titanium, Copper	1	
	➤ Lead, Zinc	1	
III	➤ Study of Important Non-Metallic minerals: Origin, Occurrence, Distribution in India and Uses of	2	9
	➤ Asbestos, Mica	1	
	➤ Barytes, Talc, Ceramic Minerals	1	
	➤ Building Stones, Cement Raw Materials, Mineral Pigments	1	
	➤ Refractory Materials, Abrasive Minerals	1	
	➤ Fertilizer Minerals and Gemstones	1	
	➤ Mineral Economics: Significance of Minerals in National Economy Demands and Supplies, Substitutes.	1	
	➤ Market Economy - Essential, Critical and Strategic Minerals.	1	
IV	➤ Mineral Exploration Techniques: Panning of Soils and Their Interpretation	1	9
	➤ Trenching – Pitting – Exploratory Drilling and Calculation of Grades.	1	

	➤ Sampling and Surface Mining: Methods of Investigation of Ore Bodies:	1	
	➤ Mineral Sampling Techniques.	1	
	➤ Ore reserves estimation.	1	
	➤ Introduction to Mining: Classification of Mining Methods.	1	
	➤ Cycles of Mining Operation. Surface Mining,	1	
	➤ Drilling Methods and Types of Drills.	1	
	➤ Mine Explosives and Bench Parameters, Mine Haulage.	1	
	Sub Surface Mining And Mine Environment: Subsurface mining methods.	2	
V	➤ Basic concepts. Shaft, adit, winze, raise, stope, mine support and ventilation.	2	9
	➤ Outline of underground coal mining methods.	1	
	➤ Mine machineries, organization and structure of a mine.	1	
	➤ Role of a geologist in mining industry.	1	
	➤ Mining legislations. Preparation of mine plans, mining scheme.	1	
	➤ Environmental Impact Assessment and Management Plans, Mine Accidents, Miner's Diseases.	1	

Specific outcome of Learning:

At the end of this course the student will be able to,

1. Describe the process of Ore formation.
2. Categorize the Salient Metallic mineral groups.
3. Assess the Mineral Exploration Techniques and Sampling and surface mining methods.
4. Formulate the Scientific questions about the Underground mining methods.
5. Analyse the Mineral economic strategies.

Text Book

1. Arogyaswami, R.N.P. Course in Mining Geology, Oxford and IBH Publishing house. 1980.
2. Bateman, A. Economic Mineral Deposits, John Wiley, 2013.
3. Rao, D.P. Remote Sensing for Earth Resources, Second Edition, Association of Exploration Geophysicist, Hyderabad, 1999.

Reference Book

1. Alistair R. Brown, Interpretation of Three Dimensional Seismic Data, American Association of Petroleum Geologists, USA, 1986.
2. Edwards, R. & Atkinson, K., Ore Deposit Geology, Chapman & Hall, London. 1986.
3. Gokhale & Roa, Ore Deposits of India, Thomson press, 2010.
4. Iyengar, N.K.N. Mineral wealth of Tamilnadu, Madras Govt., 1978.
5. Levorsen A.I., Geology of Petroleum, CBS Publishers and Distributors, Delhi, Second Edition, 1985.
6. Parbin Singh, "Engineering and General Geology", S.K. Kataria & Sons, New Delhi, 2013.
7. Umthay, R.M., Mineral Deposits of India. Batisons, 2006.
8. Sinha, R.K. & Sharma, N.L., Treatise on industrial minerals of India. 1967.

15GGMP0210	ENVIRONMENTAL GEOLOGY AND NATURAL DISASTER MANAGEMENT	Credit - 3
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Objectives: The student is introduced to the advanced and applied aspects of Environmental geology and Natural Disaster Management. The methodology of teaching involves class lectures with problem solving exercises and simple laboratory demonstrations.

Unit	Lecture Content	Lecture Hours	Total Lecture Hours / Unit
I.	➤ Environmental Geology: Fundamental Concepts of Environmental Geology, Its Scope and Necessity.	2	9
	➤ Geoinformatics in Mapping Mine Pollution.	1	
	➤ Acid Mine Drainage, Heavy Metal Pollution, Surface and Ground Water Pollution	2	
	➤ Mapping of Hazards due to Radioactive Wastes	1	
	➤ Rock Water Interaction and Fluorosis / Arsenic Pollution	1	
	➤ Site Selection for Solid - Radioactive, Liquid Waste Disposal.	2	
II.	➤ Impacts of Over Draft of Ground Water and Sand Mining.	1	8
	➤ Eco Degradation in Hill, Plain, Riverine, Coastal, Aeolian, Glacial and Volcanic System - EIA.	2	
	➤ Soil: Soil Type and Classification- Survey Methods	1	
	➤ Geoinformatics in Mapping Soil Erosion and conservation measures.	2	
	➤ Land use/cover: Spatio-Temporal Studies - Eco Degradation - Eco Restoration	2	
III.	➤ Natural Hazards, Zoning, Risk Assessment and Management: Extreme events and Hazards	2	9
	➤ Catastrophic Geological Hazards, Study of Subsidence, Floods, Earthquakes, their Causes, Classifications, Assessment, Prediction and Prevention.	3	
	➤ Tsunami Disasters: Tsunami Inundation Mapping using Field & Satellite Data.	1	
	➤ GIS based Elucidation of Interface Dynamics between Tsunami & Coastal Land Systems – Mitigation Strategies.	2	
	➤ Run Up and Inundation for Warning Models – Tsunami. Vulnerability Mapping.	1	
IV.	➤ Global Warming and Ozone Layer Depletion.	1	10
	➤ Coastal Hazards, Cyclones, Tsunamis, and Shoreline and Sea Level Changes.	2	
	➤ Strategies for Hazard Mitigation.	1	
	➤ Remote Sensing and GIS Based Mapping of Lineament Anomalies.	2	
	➤ Coastal & Aeolian- Resistivity Anomalies - Gravity & Other Geophysical Anomalies.	2	
	➤ Ground Water Anomalies - Historic Seismic Data Analysis	1	
	➤ GIS Integration and Seismo Tectonic Mapping.	1	
V.	➤ Remote Sensing & GIS in Landslides and Slope Stability: Mapping of Landslides Morphology	1	9
	➤ Landslides Classification Geological and Triggering Parameters	1	

➤Remote Sensing GIS based LHZ (integrated slope mapping, integrated terrain analysis, parametric ranking method, BIS and other methods)	2	
➤Factor of Safety	1	
➤Geotechnical Investigation- Risk Assessment- Mitigation Strategies	2	
➤Landslides Forewarning System.	1	
➤Applications of Remote sensing & GIS in other Disasters.	1	

Specific outcome of Learning:

At the end of this course the student will be able to,

- 1.Assess the basics of Environmental Geology And Natural Disaster Management*
- 2.Describe the concept of Natural Disaster Management*
- 3.Analyse the risk and mitigation of hazards.*
- 4.Identify the remote sensing technology and GIS for natural disaster management.*
- 5.Analyse the Natural Disaster Management through Geospatial technology.*

Text Book

- 1.Jonathan Turk And Graham R. Thompson, Environmental Geoscience: Saunders College Division, 2000,

Reference Book

- 1.Chouhan, T.S. & Joshi, K.N., Applied Remote Sensing and Photo Interpretation, Vigyan Prakashan, 1996.
- 2.Edward A. Keller, Environmental Geology (8th Edition) Prentice Hall, 1999.

15GGMP0211	DIGITAL IMAGE PROCESSING AND GEOCOMPUTING	Credit-3
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Objectives: This subject introduces the student to the different aspects of Digital image processing and Geocomputation. The methodology of teaching involves class lectures with problem solving exercises and simple laboratory demonstrations.

Unit	Lecture Content	Lecture Hours	Total Lecture Hours / Unit
I.	Principles of Image Processing: Digital Image formats - Image Processing systems - Raster & Vector files.	2	9
	Image Rectification & Restoration: Geometric Errors: Sources of Errors, Correction Processes.	4	
	Radiometric errors: Sources of errors, correction processes.	3	
II.	Image Enhancement: Single Band Enhancement:	1	10
	Image Reduction & Magnification,	1	
	Contrast Stretching,	1	
	Filtering & Edge Enhancement	1	
	Multiband Enhancement:	1	
	Band Rationing,	1	
	Colour Composites Generation,	2	
	Principal Component Analysis, NDVI.	2	
III.	Image Classification: Pattern Recognition	2	10
	Supervised classification	3	
	Unsupervised classification	1	
	Sub pixel classification	2	
	Classification accuracy assessment.	2	
IV.	Multi-Mode Image Analysis:		9
	Image Registration	3	

	Multisensor & Multimode data fusion	2	
	Different image processing packages. ERDAS ENVI	4	
V.	Computer Applications in Geology Introduction to Geological softwares AQUA	1	10
	Aqua hem Rock ware	1	
	Petro plot Stereo win	1	
	Igpet IPI2WIN	1	
	Surfer	1	
	Petrograph Triplot	1	
	SPSS Statistica Origin	2	
	Other Recent Geological Softwares and its Applications.	1	
	Mobile Android Geological Softwares and its Applications.	1	

Specific outcome of Learning:

At the end of this course the student will be able to,

1. Describe the Principles of Digital Image Processing.
2. Identify the Image enhancement techniques and its applications.
3. Identify the Image Classification techniques and its applications.
4. Categorize the Geological Softwares and its applications.
5. Describe the Multimedia Applications in Geology.

Text Book

1. Curran, P. Principles of Remote Sensing, Longman, London. 1985.
2. Nilblack, W. An Introduction To Digital Image Processing, III Edition, Prentice Hall International. 1986.

Reference Book

1. Hord M.P, Digital Image Processing or Remotely Sensed Data, Academic Press. 1982.
2. Jenson, Introduction to digital image processing, Prentice Hall: 3 Edition, 2004.
3. Lillisand, T.M. and Kiefer, P.W, Remote Sensing and Image Interpretation, John Wiley & Sons, New York. 2003.
4. Paul J. Gibson and Clara H. Power, Introductory Remote Sensing, Digital Image Processing and Applications, Routledge, 2000.
5. Pratt, S.K. Digital Image Processing, Wiley - Inter Science, New York. 1990.

15GGMP02M1	Modular Course - MEDICAL GEOLOGY	Credit - 2
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Objectives: Medical Geology and Geosantiation are the application of geology to different life systems and landform systems and their management. The teaching and learning methodology involves class lectures, practical and laboratory demonstrations.

Unit	Lecture Content	Lecture Hours	Total Lecture Hours / Unit
I	Medical Geology – Definition. Introduction to Remote Sensing and GIS application in Health Care Studies.	2	16
	Food and Nutritional Practices – Traditional terrain based lifestyle (<i>Kurinji- Mullai- Marutham- Neithal- Paalai</i>). Food as Medicine – Home Medicine.	2	
	Geo-chemistry - Minerals, trace elements, Contaminants Toxicities & Deficiency mapping.	2	
	Geo-demography – Terrain facility and settlement GIS: (human behavior and animal behavior interactions with natural resources for health)	2	
	Health GIS – Definition, Health issues and GIS application.	2	
	GIS in health planning and management – Prevention of occupational health hazards in mining industry. Health care of the community.	2	
	Water GIS – Water quality, Criteria & Standards.	1	
	Sanitation GIS – GIS based waste management and health issues.	1	
	Toilet GIS - GIS based Toilet construction. Community latrines management.	1	
Pollution GIS – Geo-biodiversity. Health issues of different type of pollution.	1		
II	Type of Disaster and Health Consequences - Public health issues of disasters	2	16
	Basic human ailments and First aid Kit - List of medicines in “First Aid Kit”	2	
	Geo-Psychiatry - Disaster Related Depression - Suicides- Emotional Stress – Alcoholism – Need for counseling	4	
	Geo-physics and Geo-architecture – Light energy, sound energy, magnetic energy, electrical and electronic energy, thermal energy. Air – velocity, ventilation, humidity. Solar energy, cosmic energy. Earth radiation and Isotopes.	8	

Specific outcome of Learning:

At the end of this course the student will be able to,

1. *Describe the concept of Medical Geology*
2. *Categorize the various branches of Medical Geology*
3. *Formulate the scientific questions about personal hygiene and interaction between biotic and abiotic systems.*
4. *Identify the key factors to promote sanitation and public health.*
5. *Analyze qualitative data systematically by selecting appropriate analysis.*

Text Book

1. Park, K., Park's Text book of Preventive and social medicine, M/s Banaras bhanot publishers Jabalpur.2013,

Reference Book

1. David Werner et. al., "Where there is no doctor", Reprinted, Macmillan, 1993.
2. Singh, R.Y., Geography of settlement, Reprinted, Rawat publications, 2007.
3. Purohit, N.J., Earth Science, Geology (Environmental and the Universe), 1st Edition, 2014, Swastik Publications, New Delhi, India
4. Gurugnanam, B., Essential of Hydrology, 2009, New india publishing agency, New Delhi, India.
5. Pradeepkumar, A.P. et al., Disaster risk and Vulnerability conference, 24-26 April 2014, Proceedings of the 2nd DRVC.
6. Skinner C.H and Berfer R.A., Geology and Health, 2000, Oxford University Press.
7. Selinus (Ed), Essentials of Medical Geology, Elsevier, 2000.
8. Gurugnanam, B., Geographical Information System, New India Publishing, 2009.
9. Anji Reddy, Textbook of Remote Sensing and Geographical Information System, 3rd edition, BS publication, 2010.

15GGMP02M2	Modular Course - MICROPALEONTOLOGY	Credit - 2
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Objectives: *Paleoecology and Paleoenvironment studies are the application of geology to different life systems and landform systems and their management. The teaching and learning methodology involves class lectures, practical and laboratory demonstrations.*

Unit	Lecture Content	Lecture Hours	Total Lecture Hours / Unit
I	Surface and subsurface sampling method	2	20
	Processing of samples	2	
	Morphology, classification and evolution of foraminifera	4	
	Stratigraphy of foraminifera with special reference to India	2	
	Biometrics of of larger foraminifera	2	
	Paleoenvironmental interpretation using microfossils	2	
	ostracoda	1	
	Nanofossils	1	
	Radiolaria	1	
	Conodonts	1	12
	Bryozoa	2	
	Role of micropaleontology in hydrocarbon exploration	2	
	Deep sea records with reference to Indian Ocean	4	
	Stable isotopic study in foraminifera and interpretation of paleotemperature and paleoenvironment reconstruction	8	

Specific outcome of Learning:

At the end of this course the student will be able to,

1. *Describe the concept of Micropaleontology*
2. *Categorize the various branches of Micropaleontology*
3. *Identify the importance of Micropaleontology on environment.*
4. *Analyze qualitative data systematically by selecting appropriate ecological analysis.*
5. *Analyse the environmental and ecological significance of foraminifera and ostracoda*

Text Book

1. Bignot, G., 1985: *Elements of Micropalaeontology*. Graham and Trotman.
2. Haq, B.V. and Boersma, A., 1998: *Introduction to Marine Micropalaeontology*. Elsevier.
3. Haynes, J.R., 1981: *Foraminifera*. John Wiley.

15GGMP0212	IGNEOUS AND METAMORPHIC PETROLOGY AND ECONOMIC GEOLOGY - PRACTICAL III	Credit – 2
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Objectives: This practical introduces the student to the different aspects of practical Petrology, Economic geology, Ore reserve estimation and their applications. The teaching and learning methodology involves practical and laboratory demonstrations with rock specimens and thin sections, and working out methods of calculating rock compositions and others.

1. Megascopic Identification of Igneous, Metamorphic and Sedimentary rocks.
2. Microscopic Identification of Rock Fabrics, Mineral assemblages of Igneous and Metamorphic rocks.
3. Calculation of C.I.P.W. Norm.
4. Niggli values, variation diagrams: Binary- Harker, Niggli, Ternary variation diagrams.
5. ACF, AKF and AFM diagrams.
6. REE distribution patterns and Petrogenetic significance of rocks.
7. Identification of economic minerals in hand specimen.
8. Study of optical properties of opaque minerals in reflected light and their identification in polished thin section.
9. Study ore textures and interpretation of paragenesis.

Specific outcome of Learning: The student gains an understanding of the methods of practical Petrology, Economic Geology and ore reserve estimation useful for routine laboratory work. The megascopic and petrographic aspects of the practical find use in field geology and ore reserve estimation done in most mining, mineral and oil exploration industries.

15GGMP0213	ORE RESERVE ESTIMATION AND DIGITAL IMAGE PROCESSING - PRACTICAL IV	Credit - 2
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Objectives: *This practical introduces the student to the different aspects of practical Ore reserve estimation and their applications. The teaching and learning methodology involves practical and laboratory demonstrations with ore reserve estimation methods and solving image processing exercises and simple laboratory demonstrations.*

1. Estimation of ore reserves.
2. Exploring the Digital Image Processing Software Interface and Working with True and False Color Composite using remotely sensed data sets.
3. Portal, and Blend, Flicker, Swipe and Geolinking.
4. Overlay of Vector Layer over Image.
5. Reading Raw Image, Reproject Raster and Geometric Correction.
6. Spatial and Spectral Subset.
7. Image Enhancement/ Stretch, Apply Spatial Filter, Mosaic.
8. Pan sharpening.
9. Density Slicing
10. NDVI Calculation.
11. Principal Component Analysis (PCA).
12. Change Detection, Anomaly Detection.
13. Spectral Analogues Tool for Vegetation Delineation.
14. Relative Water Depth Analysis.
15. Unsupervised Classification.
16. Post Classification Analysis: Class Combine.
17. Post Classification Analysis: Class Recode.
18. Post Classification Analysis: Class Identification.
19. Post Classification Analysis: Filtering, Vectorization.
20. Supervised Classification, Accuracy Assessment, Generation of Class Statistics.
21. Generation of DEM from Line Features
22. Generation of Contours from DEM
23. Generation of Slope and Aspect
24. Generation of Line of Sight
25. Atmospheric Correction
26. Exploring the basic principles of geological softwares.

Specific outcome of Learning: *The students gain knowledge in ore reserve estimation done in most mining, mineral and oil exploration industries. The student gains insight into the advanced and applied aspects digital image processing.*

15GGMP0314	SEDIMENTARY PETROLOGY AND MARINE GEOLOGY	Credit - 4
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Objectives: Petrology is the study of rocks. It involves field geology, megascopic and thin section studies along with experimental petrology. The teaching and learning methodology involves class lectures, practical and laboratory demonstrations.

Unit	Lecture Content	Lecture Hours	Total Lecture Hours / Unit
I.	➤ Sedimentary Petrology: Physical properties of sedimentary particles and minerals - Mineral Stability and their Significance - Porosity and Permeability.	4	12
	➤ Classification and Composition of Sedimentary rocks. Textures, Structures and their Environmental Significance.	2	
	➤ Provenance of sediments - Lithification and diagenesis.	2	
	➤ Sedimentation and tectonics: tectonic control of sedimentation, geosynclines and their lithological association, plate tectonics in relation type and evolution of basins.	4	
II.	➤ Petrography, Nomenclature, Classification, Depositional Environment and Genesis of Clastic Sedimentary Rocks: Sandstones: Shales: Breccias: Conglomerates. Non-clastic sedimentary rocks: Limestones: Dolomites: Flint: Chert: and Evaporites.		13
III.	➤ Environment of Deposition: Nonmarine, Transitional and Marine Environments and products.	4	12
	➤ Outline on Grain size analysis, Heavy mineral analysis, Clay mineral analysis and palaeo environmental studies.	3	
	➤ Grain size determination: sample preparation, direct measurements, dry and wet sieving. Grain size analysis and graphical representation. Provenance of sedimentary rocks.	3	
	➤ Analysis of sedimentary rocks: XRF and SEM methods. Sedimentary basins and sedimentary depositional environments. Role of colloids in sedimentation.	2	
IV.	➤ Marine Geology: Introduction and scope of marine geology, Oceanic profile, oceanic features, beaches.	2	12
	➤ Classification of coast, erosion and accretion. Waves, currents and tides.	2	
	➤ Coastal protection structures.	2	
	➤ Classification of marine mineral deposits. Origin and depositional system of marine resources.	4	
	➤ Beach placers, shelf deposits, deep ocean phosphatic, polymetallic nodules, sulphate deposits, hydrocarbon deposits.	2	

V.	➤Sea water as a resource. Ocean circulation, turbidity current, submarine and sedimentational processes.	1	13
	➤Oceanic sediments and microfossils. Marine stratigraphy, correlation and chronology.	1	
	➤Tectonic history of the oceans. Concept of sealevel changes.	1	
	➤Seismic stratigraphy and sequence stratigraphy.	1	
	➤Physical and chemical properties of sea water. Marine pollution, path ways, resilience time, pollutants in the marine environment.	2	
	➤ Marine geological instruments: Methods of measuring properties of the sea. Sediment samplers: Van Veen grab: Peterson grab: La Fond & Dietz snapper: Phleger – corer sampler: Surficial sediment scoop: Sediment dredger.	2	
	➤Water samplers: Nansen water sampler. Environmental sensors: bathythermograph: reversing thermometer.	2	
	➤Deep sea record: Depth indicators: Secchi disc	1	
	➤Major oceanographic events in Cenozoic. Laws of the sea.	1	
	➤Remote sensing applications in ocean sciences	1	

Specific outcome of Learning:

At the end of this course the student will be able to,

1. Describe the process and formation of Sedimentary rocks.
2. Categorize the Classification of Sedimentary Rocks
3. Describe the concept of Marine geology.
4. Analyse the marine environments using marine geological instruments.
5. Identify the suitable remote sensing applications in ocean sciences.

Text Book

1. Collision, J.D. & Thompson, D.B. Sedimentary Structures. 2nd Ed. Unwin Hyman, London, 1989.
2. Ernest G. Ehlers, Harvey Blatt, Petrology Igneous Sedimentary and Metamorphic, 3rd Edition, 2005.
3. Pettijohn, F.J., Sedimentary Rocks, Harper & Row, New York, 3rd Edition, 1975.
4. Reineck, H.E., and Singh I.B. Depositional Sedimentary Environments, Springer Verlag, 1980.
5. Sengupta, S., Introduction to Sedimentology, CBS Publishers and Distributors, 2011.
6. Wernest, G. Ehlers and Harvey Blatt, Igneous, Sedimentary and Metamorphic Rocks, CBS Publishers and Distributors, New Delhi, 1999.

15GGMP0315	HYDROGEOLOGY AND ENGINEERING GEOLOGY	CREDIT 4
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Objectives: *Hydrogeology is the study of water in the geological domains. Engineering Geology is the application of geology to engineering projects. The teaching and learning methodology involves class lectures, practical and laboratory demonstrations with equipment available in the Department.*

Unit	Lecture Content	Lecture Hours	Total Lecture Hours / Unit
I.	➤ Hydrological Properties of Rocks: Porosity, Permeability, Specific Yield and Retention, Base Flow, Transmissivity and Storage Coefficient.	3	12
	➤ Ground Water Flow Equations: Steady and Transient Flow. Darcy's Law: Hydraulic Conductivity, Steady, Unsteady and Radial Flow.	3	
	➤ Aquifers: Types and Hydrostratigraphic Units.	2	
	➤ Pumping Tests: Definition, Methodology, Data Collection, and Interpretation by Theis, Cooper-Jacob's, and Chow's method.	2	
	➤ Drilling Methods for Groundwater Bore Wells.	2	
II.	➤ Outline of Water Quality Standards and Guidelines: WHO, BIS and ICAR. Physical Parameters of Groundwater Quality.	2	11
	➤ Analysis of Major and Minor Elements in groundwater using APHA standards.	2	
	➤ Water Quality Parameters for Drinking, Agriculture, and Industrial Uses.	3	
	➤ Graphical Representation and Interpretation of Water Quality Data: Wilcox, USSL, Gibbs plot, Piper, Donean and Durov diagrams.	3	
	➤ Coastal Aquifers: Ghyben-Herzberg relation and Saline Water Intrusion.	2	
III.	➤ Groundwater Basins: Drainage and Basin Morphometry.	2	12
	➤ Methods of determining groundwater flow and preparation of water table contour maps.	3	
	➤ Problems due to over exploitation of groundwater. Groundwater recharge: natural and artificial methods. Rainwater harvesting: definition, methods, and design of harvesting structures.	3	
	➤ Outline of methods of groundwater exploration.	2	
	➤ Groundwater provinces of India and Tamil Nadu.	2	
IV.	➤ Engineering properties of rocks: Rocks as materials for construction – Rocks as sites for construction.	3	12

	➤ Specific Gravity, Porosity, Absorption, Strength of rocks, compressive strength, tensile strength.	3	
	➤ Soil profile, soil particles, soil structure, plasticity & swelling.	2	
	➤ Decorative stones & Building Stones.	2	
	➤ Poisson's ratio and their measurement.	2	
V.	➤ Dams and reservoirs: Classification & types Problems & failures of dams.	4	13
	➤ A brief account on Major Indian Dams.	2	
	➤ Tunnels: Classification & nomenclature, Geological survey prior to tunneling.	3	
	➤ Landslides: Types & causes, Preventive measures, Road network & related problems & preventive measures, Ghats road alignment.	4	

Specific outcome of Learning:

At the end of this course the student will be able to,

1. Predict the origin and occurrence of ground water
2. Describe the hydrological properties of rocks
3. Identify the water quality standards and guidelines.
4. Analyse the Groundwater Basins.
5. Assess the Properties of Rocks for engineering purposes.

Text Book

1. David Keith Todd, Larry W. Mays, Groundwater Hydrology, Wiley, 2013
2. Fetter, C.W., Applied Hydrology, CBS Publications, 2007.
3. Gurugnanam, B., Essentials of Hydrogeology, 2005.
4. Herman Bouwer, Groundwater Hydrology, McGraw Hill Education Private Limited 2014.
5. Raghunath, H. M., Groundwater, New Age International Publications, 2003.

Reference Book

1. Deman, M.C.J. Smith G.S and Verstappen, H.T. (eds), Remote Sensing for resources development and environmental management, A.A. Balkema Publishers, Rotterdam, Netherlands. 1986.
2. Paine, D.P., Aerial photography and image interpretation for resource management, Wiley and Sons, New York. 1981.
3. Ramakrishnan, S. Groundwater, CBS Publishers & Distributors, 1998.

15GGMP0316	PETROLEUM GEOLOGY, COAL GEOLOGY AND GEOTHERMAL RESOURCES	CREDIT 4
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Objectives: The student is introduced to the advanced and applied aspects of petroleum, coal, and Geothermal Resources. The methodology of teaching involves class lectures with problem solving exercises and simple laboratory demonstrations.

Unit	Lecture Content	Lecture Hours	Total Lecture Hours / Unit
I.	➤ Petroleum Geology: Properties of petroleum: Origin and Theories: Organic and Inorganic Processes.	3	12
	➤ Environment of Oil Formation: Sedimentary Basins - Continental and Offshore.	3	
	➤ Migration and Accumulation of Petroleum	2	
	➤ Geological Factors Controlling Hydrocarbon Migration: Forces Responsible for Migration,	2	
	➤ Migration Routes and Barriers.	2	
II.	➤ Mode of Occurrence of Petroleum: Surface and Subsurface Occurrence.	2	12
	➤ Characteristics and Types of Reservoir Rocks: Porosity, Permeability, and Reservoir Fluids.	4	
	➤ Petroleum Provinces.	2	
	➤ Global Distribution of Petroleum Reserves.	2	
	➤ Petroliferous Basins of India	2	
III.	➤ Coal geology: Physical Properties, Chemical Composition.	2	12
	➤ Classification of Coal: Rank and Grade.	2	
	➤ Origin of Coal: Lithologic characters of Coal: Bed Structure, Coal Texture.	2	
	➤ Maceral Concept: Vitrain, Clarain, Durain and Fusain. Coke, Coal for Liquefaction.	2	
	➤ Coal bed methane, origin and occurrence.	2	
	➤ Coal Gasification- Beneficiation of Low Grade Coal and Conservation.	2	
IV.	➤ Occurrence of Coal: Coal Forming Epochs in the Geologic Past.	3	13
	➤ Geological and Geographical Distribution of Coal in India.	2	
	➤ Detailed study of important Coal Fields in India.	2	
	➤ Neyveli Lignite Deposits.	2	
	➤ An Outline of Estimation of Coal Reserves.	2	
V.	➤ Geothermal Resources – Geothermal Energy- Various Types, Availability, Size, Distribution-Recovery,	2	
	➤ Applications and Economics of Geothermal Energy.	2	

➤Mineralogy of the Nuclear Metals.	1	13
➤ Distribution of U and Th in rocks.	1	
➤Geochemical Guides.	2	
➤Radiometric Prospecting Methods and Assaying	2	
➤Bore Hole Logging, Field and Airborne Surveys.	2	

Specific outcome of Learning:

At the end of this course the student will be able to,

- 1.Describe the Formation, properties, Migration and accumulation of Petroleum.*
- 2.Identify the Occurrences of Petroleum.*
- 3.Describe the Characteristics of Coal.*
- 4.Identify the Occurrences of Coal.*
- 5.Predict the Geothermal Resources and uses.*

Text Book

1. Alexey F. Bunlein and Konstantin I-Voliak, Lasser Remote Sensing of the Ocean Methods and Applications – Wiley Series, John Wiley & Sons. inc. New York, 1959.

Reference Book

1. Alistarir R. Brown, Interpretation of Three Dimensional Seismic Data, American Association of Petroleum Geologists, USA, 1986.
2. Aswathanarayana, U., Principles of Nuclear Geology. NBT. Delhi. 1985.
3. Gary L. Prost, Remote Sensing for Geologists - A Guide to Image interpretation, Gordon and Breach Science Publishers, The Netherlands. 1997.
4. Levorsen A.I., Geology of Petroleum, CBS Publishers and Distributors, Delhi, Second Edition, 1985.
5. Paine, D.P., Aerial photography and image interpretation for resource management, Wiley and Sons, New York. 1986.
6. Rao, D.P. Remote Sensing for Earth Resources, Second Edition, Association of Exploration Geophysicist, Hyderabad, 1999.

15GGMP0317	EXPLORATION GEOPHYSICS AND GEOCHEMISTRY	Credit - 4
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Objectives: Geophysics and Geochemical exploration constitutes the application of geophysics and geochemistry in mineral exploration. The teaching and learning methodology involves class lectures, practical and laboratory demonstrations.

Unit	Lecture Content	Lecture Hours	Total Lecture Hours / Unit
I.	➤ Properties of the earth: Gravitational, Electrical, Magnetic, Thermal and Chemical.	2	12
	➤ Definition, Principles, Instruments, Field's procedures of Gravity Methods.	2	
	➤ Anomalies applications and limitations of Gravity Methods.	2	
	➤ Definition, Principles, Instruments, Field's procedures of radioactive methods.	2	
	➤ Anomalies Applications and Limitations of Radioactive Methods.	2	
	➤ Radioactive Elemental Surveys.	2	
II.	➤ Definition, Principles, Instruments, Field's procedures of Magnetic Methods.	2	11
	➤ Anomalies applications and limitations of Magnetic Methods: limitations of Magnetic Methods.	3	
	➤ Definition, Principles, Instruments, Field's procedures of Electromagnetic Methods	3	
	➤ Anomalies applications and limitations of Electromagnetic Methods: Brief outline of Telluric and Magneto Telluric Fields.	3	
III.	➤ Definition, Principles, Instruments, Field's procedures of Electrical Methods	2	12
	➤ Anomalies applications and limitations of Electrical Methods: Electrode Configurations	2	
	➤ Wenner – Schlumberger – Gradient – Pole – Dipole and Dipole.	3	
	➤ Dipole Methods. Interpretation of Resistivity Data.	3	
	➤ Self Potential and Induced Polarization Methods.	2	
IV.	➤ Definition, Principles, Instruments, Field's procedures of Seismic methods	2	13
	➤ Anomalies applications and limitations of Seismic methods.	1	
	➤ Refraction Methods and Reflection Methods.	2	
	➤ Geological exploration: prospecting criteria of various mineral deposits.	2	
	➤ Ore guides, regional and local parameters for exploration.	2	
	➤ Regional and detailed exploration.	2	
	➤ Drilling methods: selection sites, angle and direction of bore holes, logging, bore hole deviation.	2	

V.	➤ Exploration Geochemistry: Outline and Classification of Elements. Geochemical Anomaly and Province.	2	13
	➤ Geochemical cycle.	1	
	➤ Primary and Secondary Dispersion of elements: Controls of dispersion.	1	
	➤ Mobility of elements.	1	
	➤ Application of Utility of path finder elements and minerals Geochemical surveys: Definition – Types.	2	
	➤ Sampling Methodology – Application to mineral deposits.	2	
	➤ Outline of analytical methods used in Exploration Geochemistry.	2	
	➤ Short account on geo-botanical prospecting.	2	

Specific outcome of Learning:

At the end of this course the student will be able to,

1. Describe the basic principles, Field procedure and application of Gravity methods and radioactive methods for Geological studies.
2. Analyse the basic principles, Field procedure and application of Magnetic methods and Electro Magnetic methods for Geological studies.
3. Evaluate the basic principles, Field procedure and application of Electrical Methods and Radioactive methods for Geological studies.
4. Assess the basic principles, Field procedure and application of Refraction methods and Reflection methods for Geological studies.
5. Describe the basic principles of Exploration Geochemistry.

Text Book

1. Lowrie, W., Fundamentals of Geophysics. 2nd ed. Cambridge University Press, New Delhi, 2007.
2. Ramachandra Rao, M.B., Outlines of Geophysical Prospecting. EBD, Dhanbad, 1993.
3. Telford, W.M., Geldart, L.P. & Sheriff, R.E., Applied Geophysics. 2nd ed. Cambridge University Press, New Delhi, 1990.

Reference Book

1. Arogyaswamy, R.N.P., Courses in Mining Geology. Oxford & IBH, New Delhi, 1980.
2. Banerjee, P. K. & Ghosh, S. Elements of Prospecting for Non Fuel Mineral Deposits. Allied Publishers, Chennai, 1997.
3. Dobrin, M. B. & Savit, C.H., Introduction to Geophysical Prospecting. 4th ed. McGraw Hill. New Delhi, 1988.
4. Hartman, H. L., SME Mining Engineering Handbook. SMME Inc. Colorado 1992.
5. Hawkes, H. E., Principles of Geochemical Prospecting. Bulletin 1000F. USGS, 1959.
6. Kearey, P., Brooks, M & Hill .I. An Introduction to Geophysical Exploration, 3rd ed. Blackwell Science., 2002.
7. Moon, C. J., Whateley, M. K. G. & Evans, A. M., Introduction to Mineral Exploration. Wiley Blackwell, New Delhi, 2006
8. Mussett, A.E. & Khan, M.A., Looking into the Earth: An introduction to Geological Geophysics. Cambridge University Press, New Delhi, 2000.
9. Parasnis, D.S, Principles of Applied Geophysics. Chapman & Hall. New York., 1975.
10. Sharma, P.V., Environmental and Engineering Geophysics. Cambridge University Press, New Delhi. 1997.

15GGMP03E3	MAJOR ELECTIVE - RDBMS, GEOGRAPHIC INFORMATION SYSTEM AND GEOCOMPUTING	Credit - 4
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Objectives: RDBMS and GIS are subjects that utilize laboratory and computer based manipulation of digital imagery for geological applications such as tectonics, mineral exploration, and others. The student is introduced to the different methods of RDBMS and GIS and their field applications with appropriate Indian examples where necessary. The teaching and learning methodology involves class lectures, practical and laboratory demonstrations with equipment available in the Department.

Unit	Lecture Content	Lecture Hours	Total Lecture Hours / Unit
I.	➤ Basics: Introduction to DBMS: Data – Information – Data Vs. Information – Database Approach – Advantages.	1	12
	➤ Data Type: Dichotomous – Categorical – Ranked – Count – Continuous, DBMS Vs. RDBMS: File and Table Concept, Data Retrieval: Operators – Boolean Conditions, Structured Query Language (SQL).	1	
	➤ Data Manipulation Language – Data Definition Language – Transaction Control Language, Joining Data and Relationship Class.	1	
	➤ GIS Overview: Introduction to GIS and GIS Infrastructure.	1	
	➤ GIS hardware components and GIS roles.	1	
	➤ Geographic data and database	1	
	➤ Data and information definitions	1	
	➤ Geographic data: spatial data, types of GIS database and discrete and continuous data	2	
II.	➤ GIS data characteristics Spatial Data Relationships, Proximity Relationships	2	12
	➤ Time and GIS data	1	
	Raster and vector data: Raster and Vector data and Models	3	
	➤ Raster data: Raster Coding, Resolution, Gridding and Linear features	2	
	➤ Raster Precision and Accuracy	1	
	➤ Vector Data	1	
	➤ Raster and Vector Structures	1	
	➤ Raster and Vector Advantages and Disadvantages	1	
	➤ Topology, Applying Topology	1	
	➤ Topology Tables	1	
III.	➤ Multiple Connectivity	1	13
	➤ Topology and Relational Queries	1	
	➤ Topology contribution	1	
	➤ Data entry: Introduction	1	
	➤ Data quality: Error, Accuracy, Precision	2	
	➤ Generalization and derived data	1	
➤ Scale and Precision, scale differences, scale incompatibility	1	13	
➤ Area and coverage, Incomplete Coverage, Smallest Scale Rule	1		
➤ Data Problems, Continuous Data Interpretation, Complete And Consistent Data	2		

	➤ Acquiring and Distribution of data: Data Accessibility, Data Cost, Data Standards, Meta Data	2	
	➤ Distributed GIS: Advantages and Disadvantages	1	
	➤ Online GIS	1	
	➤ Open GIS	1	
IV.	➤ Inventory operations and basic Analyses: Viewing GIS, Database reading	1	12
	➤ Database Queries and Summaries	1	
	➤ Relational Database Queries, Boolean Queries and Graphical Selection Queries	2	
	➤ Measurement and Types, Distance applications, Reports	1	
	➤ Theme Modification : Subsets and Tiles ➤ Spatial deletes, dissolve and merge ➤ Recoding and reclassification	1	
	➤ Basic Analyses: Introduction	1	
	➤ Overlay, Visual Overlay, Data Merging Overlay, Overlay Principles	1	
	➤ Intersect and union, Overlay options, clip options	1	
	➤ Mask and Replace Database Merging and Applying Theme	1	
	➤ Buffers and applications, Spatial analyses ➤ Statistical Reporting and Graphing	1	
V.	Advanced analyses: ➤ Proximity analyses, Nearest features, Spider diagrams, Distance selection, Aggregation	1	12
	➤ Spatial operations: Centroids, Thiessen polygons	1	
	➤ Tracking GIS	1	
	➤ Terrain analyses: Elevation analyses, Terrain profiles	1	
	➤ 3D views, Slope and Aspect, Shaded Relief views and View analyses	1	
	➤ Overlays and Additional features, Dropping, Perspective views and Z data views	1	
	➤ GIS output: types, Maps, Legends and Supporting elements	1	
	➤ Future GIS	1	
	➤ Computer Applications in Geology: Introduction to Geological softwares - AQUA, Aquachem	1	
	➤ Rockware, Petroplot, Stereowin, Igpct, IPI2WIN, Surfer, Petrograph, Triplot	1	
	➤ SPSS, Statistica, Origin.	1	
	➤ Other Recent Geological Softwares and its Applications.	1	
➤ Mobile Android Geological Softwares and its Applications.	1		

Specific outcome of Learning:

The student gains useful insight into RDBMS and GIS which may be useful for both competitive exams and job prospects related to mineral and oil exploration industries.

Text Book

1. Burrough, P.A Principles of Geographical Information Systems for Land Resources Assessment, Clarandone Press, Oxford, 1986.
2. Tor Bernhardsen, “Geographic Information System – An introduction”, third edition, 2007

Reference Book

1. Kang - Tsung Chang, Introduction to Geographic Information System, MC Graw Hill, Boston. 2002.
2. Campbell, J, Introductory Cartography, Printers Hall Englewood Cliffs, N.J, 1984.
3. Dent B.D, Principles of Thematic Map Design, Addition - Wesley, Reading, Mass. 1985.
4. Freeman, H and Pieroni, GG. Map Data Processing, Academic Press, New York. 1980.
5. Gurugnanam, B., Geographic Information System, New India Publishing Agency, 2009.

15GGMP03E1	MAJOR ELECTIVE - EXPERIMENTAL PETROLOGY	Credit – 4
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Objectives: This subject introduces the student to the different aspects of Experimental petrology. The methodology of teaching involves class lectures with problem solving exercises and simple laboratory demonstrations.

Unit	Lecture Content	Lecture Hours	Total Lecture Hours / Unit
I.	➤ Experimental Petrology: High Temperature – Pressure Techniques,	3	11
	➤ Hydrothermal apparatus and Piston Cylinder,	4	
	➤ Experiments on Solid – Solid Dehydration and Decarbonation Reaction.	4	
II.	➤ Thermodynamics: Gibb’s Energy and equilibrium constant, mole fraction, activity coefficients.	4	12
	➤ Regular and sub regular solutions.	4	
	➤ Standard states, fugacity and activity.	4	
III.	➤ Raoult’s Law, Henny’s Law, Heat Capacity,	4	12
	➤ Evaluation and tabulation of thermodynamic data.	4	
	➤ Isobaric thermal expansion and pressures.	4	
IV.	➤ Calibrations of Geothermometers and geobarometers from thermodynamic and experimental data.	6	12
	➤ Reduced activity of water from dehydration reactions.	6	
V.	➤ Log tO ₂ from oxidation reactions.	10	10

Specific outcome of Learning: The student gains insight into the advanced and applied aspects of experimental petrology

Text Book

- 1.Chatterjee. N.D. Applied Mineralogical Thermodynamics. Springer Verlag. 1991
- 2.Koch, G.S and Link, R.F. Statistical Analysis of Geological Data. John Wiley. 1970

Reference Book

- 1.Powell, R. Equilibrium Thermodynamics in Petrology, an Introduction, Harper & Row. 1978.
- 2.Wood, B.J. and Frasser, D.G Elementary Thermodynamics for Geologists. Oxford Univ. Press. 1976

15GGMP03E2	MAJOR ELECTIVE - ADVANCED ORE GEOLOGY	Credit 4
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Objectives: This subject introduces the student to the different aspects of Advanced Ore Geology. The methodology of teaching involves class lectures with problem solving exercises and simple laboratory demonstrations.

Unit	Lecture Content	Lecture Hours	Total Lecture Hours / Unit
I.	➤ Modern concepts of ore-genesis: Detailed study of all principal ore mineral groups, their textures and structures.	4	12
	➤ Chemistry of ore minerals and host rocks. Paragenesis, paragenetic sequences and zoning in metallic ore deposits.	4	
	➤ Methods in geothermometry, geobarometry in ore-geology.	4	
II.	➤ Stable and radiogenic isotopes of ores and the host rocks: Specialized models of ore deposits related to mafic and intermediate to felsic intrusions.	6	12
	➤ Vein-deposits and ore deposits related to subareal and submarine volcanism.	6	
III.	➤ Detailed study of ore deposits formed as chemical precipitates, syngenetic clastic beds and by weathering.	6	13
	➤ Significance of stratiform and strata-bound ore deposits of sedimentary affiliation and those of metamorphic affiliation.	6	
IV.	➤ Plate Tectonics and ore-genesis. Ore deposits of oceanic crust, ocean floor and those related to plate subduction.	6	12
	➤ Geological modeling for mineral exploration.	6	
V.	➤ Advance study of ore mineral textures and their application in paragenesis.	4	11
	➤ Application of ore microscopy in mineral technology.	4	
	➤ Geochemical modeling of ore deposits.	3	

Specific outcome of Learning: The student gains insight into the advanced and applied aspects of Advanced Ore Geology

Text Book

1. Wolf, K.H., Hand Book of Strata bound and Stratiform Ore Deposits. Elsevier. 1981.

Reference Book

1. Klemm, D.D. and Schneider, H.J., Time- and Strata Bound Ore Deposits. Springer Verlag, 1977
 2. Ramdohr, R., The Ore Minerals and Their Intergrowths. Pergamon Press, 1969.

15GGMP0318	GEOPHYSICAL, GEOCHEMICAL EXPLORATION METHODS AND HYDROGEOLOGY - PRACTICAL V	Credit - 2
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Objectives: This practical introduces the student to the different aspects of Geophysical, Geochemical survey methods and Hydrogeology. The methodology of teaching involves class lectures with problem solving exercises and simple laboratory demonstrations.

1. Resistivity survey and the interpretation for lithology and water resources.
2. Geological and structural interpretation using Gravity, Magnetic and aeromagnetic data.
3. Geological and structural interpretation using seismic data.
4. Sample preparation (A solution, B solution)
5. Geochemical anomaly map preparation and interpretation
6. Statistical analysis of geochemical data.
7. Sample preparation and preparation of A solution, B Solution.
8. Mean aerial depth of rainfall Assessment.
9. Rainfall - Arithmetic mean method Assessment.
10. Rainfall - Thiessen polygon method Assessment.
11. Rainfall – Isohyetal method Assessment.
12. Problems - Porosity Specific and Specific yield retention.
13. Major elements Analysis for water.
14. Graphical interpretation of water quality data.
15. Water Quality - Irrigation use Assessment.
16. Pumping test data interpretation.
17. Isohyetal map generation through surfer software.

Specific outcome of Learning: The student gains insight into the advanced and applied aspects of Geophysical, Geochemical survey methods and Hydrogeology.

15GGMP0319	PRACTICAL VI- GEOGRAPHIC INFORMATION SYSTEM AND RDBMS	Credit - 2
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Objectives: This practical introduces the student to the different aspects of Geographic Information System and Global Positioning System. The methodology of teaching involves class lectures with problem solving exercises and simple laboratory demonstrations.

1. Map Registration
2. GDB Creation
3. Feature Data Creation
4. Digitization
5. Theme Generation
6. Map layout
7. Map Generalization
8. Importing Field Photo to ArcGIS
9. GPX to ArcGIS
10. KML to Google Earth
11. Query Analysis
12. LAS Dataset & LIDAR Dataset
13. Road Network Analysis
14. Subtitle - Group of features
15. Spatial Join
16. Mosaic
17. Model Builder
18. NDVI in GIS
19. DEM in GIS
20. Image Classification
21. Line of Site Analysis
22. Pan Sharpening
23. Watershed Generation from SRTM & Contour.
24. Create Table and Input Data suitable to GIS theme such as Administrative Boundary, Road and Infrastructure Layers.
25. Retrieve data from Table by Building Queries for Various Requirements.

Specific outcome of Learning:

The student gains insight into the advanced and applied aspects of Geographic Information System and Global Positioning System.

15GGMP03M1	MODULAR COURSE - GEOSTATISTICS	Credit – 2
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Objectives: The student is introduced to the advanced and applied aspects of Mathematical Geology. The methodology of teaching involves class lectures with problem solving exercises and simple laboratory demonstrations.

Unit	Lecture Content	Lecture Hours	Total Lecture Hours / Unit
I.	➤ Geostatistics : Meaning, Definition, and History of Geostatistics,	2	12
	➤ Spatial data- Definition and Characteristics Types: Point pattern, continuous surfaces, Area with counts and aggregate rates,	2	
	➤ Terms in Spatial Analysis - Definitions of i. Spatial dependence,	2	
	➤ Stationarity and Isotropy	1	
	➤ Anisotropy	1	
	➤ Region of stationarity	1	
	➤ Spatial correlation	1	
	➤ Auto correlation	1	
II.	➤ Exploratory spatial data analysis: ESDA/EDA - Meaning of Exploratory spatial data analysis (ESDA) and Exploratory data analysis (EDA)	3	12
	➤ Concepts of data distribution in space - Data – i. Sampling, ii. Heterogeneity, iii. Dependency, Univariate description.	3	
	➤ Frequency tables, Histogram, Cumulative frequency table, Normal probability plots.	2	
	➤ Summary / Descriptive statistics, Bivariate description - Scatter plot, correlation, covariance,	2	
	➤ correlation coefficient, linear regression.	2	
III.	➤ Structural analysis: Meaning / definitions - . i. Spatial correlation, ii. Autocorrelation, and iii. Spatial Autocorrelation, Spatial autocorrelation.	3	13
	➤ Concept and “Moran’s I” statistic, Correlogram - a.concept, b.types: Omni directional and directional,	3	
	➤ Concepts of i. Autocovariance ii. Semivariances	3	
	➤ Semi variogram iv. Variogram: a.Components- Nugget variance, Sill, & Range.	3	
IV.	➤ Making predictions: Spatial interpolation - Elements and types: Global versus Local, Exact versus Inexact.	2	

	➤ Stochastic versus Deterministic, Abrupt versus Smooth.	2	13
	➤ Global interpolation - Trend, Order of polynomial, logistic option.	1	
	➤ Local Interpolation – Thiessen polygon (Vornoi plots), Inverse Distance Weighting (IDW), Spline, Kriging.	2	
	➤ Cluster Analysis: Concept, Cluster analysis- Construction of Dendograms, rooted and unrooted trees, interpreting phylogenetic relationships.	2	
	➤ Concept, Methods, Euclidean distance, Merits & demerits.	1	
	➤ Application in the studies of Earth sciences, Markov Chain Analysis.	2	
	➤ Concept and characteristics, Application in the field of Earth Sciences.	1	
V.	➤ ractical Exposure on Exploratory spatial data analysis: Univariate description - Frequency tables, Histogram, Cumulative frequency table, Normal probability plots.	2	13
	➤ Summary / Descriptive statistics. Bivariate description - Scatter plot.	2	
	➤ Correlation, covariance, correlation coefficient, linear regression	2	
	➤ Structural analysis: Variogram - Plotting of variogram.	1	
	➤ Spatial interpolation: Local Interpolation - Thiessen polygon (Vornoi plots) (manual and software) Inverse Distance Weighting (IDW), Spline, Kriging (use of software).	3	
	➤ Cluster Analysis: Problems and interpretation of results.	1	
	➤ Markov-chain analysis: Problems and interpretation of results.	1	

Specific outcome of Learning: The student gains insight into the advanced and applied aspects of Mathematical Geology.

Reference Book

1. Isaaks, E.H. and Srivastava, R.M., An Introduction to Applied Geostatistics, Oxford university Press, 561 pages., 1989.
2. Davis, J. C., Statistics and data analysis in geology, third edition, John Wiley & Sons, Singapore, 2002.
3. Using ArcGIS Geostatistical Analyst. GIS by ESRI, 2001.
4. Kitanidis P.K., Introduction to Geostatistics, Applications in Hydrogeology, Cambridge University Press, 249 pages, 1997.
5. Olea R.A., Geostatistics for Engineers and Earth Scientists, Kluwer Academic Publishers, 303 pages. Sharma, D. D, (2009), Geostatistics with applications in Earth sciences Jointly published with Capital Publishing Company. Originally published by Capital Publishing Company, 2002, 2nd ed. 2009, XVIII, 206p. 80 illus. With CD-ROM, 1999.
6. Simon W., Houlding Geostatistics: Modeling and Spatial Analysis, Springer: Har/CdrEdition (8 June 2000), **CD-ROM:** 161 pages, 2000.
7. Cressie, N.A.C. Statistics for Spatial Data, New York: John Wiley & Sons, Inc. Duetsch, C.V. and Journel, A.G. (1992), GSLIB: Geostatistical Software Library and User's Guide, New York: Oxford University Press, 1993.
8. Hohn, M.E. Geostatistics and Petroleum Geology, New York: Van Nostrand Reinhold, 1988.

15GGMP03M2	MODULAR COURSE - ADVANCED HYDROGEOLOGY	Credit - 2
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Objectives: The student is introduced to the advanced and applied aspects of hydrogeology. The methodology of teaching involves class lectures with problem solving exercises and simple field demonstrations.

Unit	Lecture Content	Lecture Hours	Total Lecture Hours / Unit
I.	➤Hydrologic cycle. Hydrographic analyses, Water balance studies	2	12
	➤Groundwater in hydrological cycle. Distribution of water in the Earth's crust.	2	
	➤Springs (including thermal): origin and movement of water. Geologic structures favouring groundwater occurrence.	2	
	➤Methods of identification of groundwater reservoir properties.	3	
	➤Fluctuation of groundwater level	3	
II.	➤Groundwater in arid and semiarid, coastal and alluvial regions.	3	12
	➤Groundwater in hard rocks and limestone terrain with reference to Indian situation.	3	
	➤Chemical characteristics of groundwater in relation to various uses - domestic, industrial and irrigation purposes	2	
	➤Water pollution and treatment. Environmental impact of groundwater extraction	2	
	➤Wells and their construction and design	2	

Specific outcome of Learning: The student gains insight into the advanced and applied aspects of Hydrogeology.

Reference Book

- 1.Chow, V.T., 1988: Advances in Hydrosience, McGraw Hill.
- 2.Walton, W.C., 1988: Ground Water Resource Evaluation. McGraw Hill. Black, W. & Others (Ed.), 1989: Hydrogeology. Geol. Soc. of America
- 3.Publ. Mahajan, G., 1990: Evaluation and Development of Ground Water. O.K. Publisher.
- 4.Singhal, B.B.S., 1986: Engineering Geosciences. Savita Prakashan.

15GGMP0420	DISSERTATION
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Non major Electives

15GEOU04N1	DISASTER MANAGEMENT	Credit - 3
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Objectives: The student is introduced to the advanced and applied aspects of Environmental geology and Natural Disaster Management. The methodology of teaching involves class lectures with problem solving exercises and simple laboratory demonstrations.

Unit	Lecture Content	Lecture Hours	Total Lecture Hours / Unit
I.	➤Earth System Sciences and Natural Disasters: Origin of the Earth Interior of the Earth	3	9
	➤Endogenic processes and exogenic processes of the Earth.	3	
	➤Type of Natural disasters: Earthquakes, landslides, floods.	3	
II.	➤Tsunami and its management.	2	9
	➤Cyclone and its management.	2	
	➤Drought, and climate change and its management.	2	
	➤Other disasters and its management.	3	
III.	➤ Disaster vulnerability mapping: Introduction to Remote Sensing and GIS in Disaster Vulnerability mapping.	2	9
	➤Earth quake vulnerability mapping.	1	
	➤Landslide vulnerability mapping.	1	
	➤Flood vulnerability mapping.	1	
	➤Tsunami vulnerability mapping.	1	
	➤Cyclone vulnerability mapping.	1	
	➤Drought vulnerability mapping.	1	
	➤Climate change vulnerability mapping.	1	
IV.	➤ Disaster Mitigation: Mitigation strategies for earth quakes, landslides, floods, tsunami, cyclone, drought, climate change	3	

	➤Industrial environmental disaster: pollution.	2	9
	➤Gas leakage - chemical and fire accident.	2	
	➤Human disaster: road and rail accidents .- field trip	2	
V.	➤ Disaster Management: Rescue -relief –rehabilitation.	2	9
	➤Short term and long term rescue operations.	2	
	➤Short term and long term relief operations short term and long term rehabilitation.	3	
	➤Dams - water shed management.	2	

Specific outcome of Learning: *The student gains insight into the advanced and applied aspects of Environmental geology and Natural Disaster Management.*

Text Book

- 1.Bangar, K.M Principles of Engineering Geology, Nem Chand Jain Publishers, 2010.
- 2.Radhakrishnan. V., General Geology, VV Publications, 2002

References Book:

- 1.Grija Bhushan Mahapatra, A Text Book of Geology, CBS Publishers and Distributors, New Delhi, 1987.
- 2.Jonathan Turk and Graham R. Thompson, Environmental Geoscience, Saunders college division, 2000.
- 3.Parbin Singh, A text book of Engineering and general Geology, publishers of engineering and computer books, 2009.
- 4.Pradeep Sahni, Madhavimalalgoda and ariyabandu , "Disaster risk reduction in south Asia". PHI
- 6.Pradyumna, P. Karan, Shanmugam, P. Subbiah: The Indian Ocean tsunami, Cambridge University press India Pvt. Ltd., 2012.
- 7.Santra S.C, Environmental Science, New central book agency, 2004.
- 8.Thomas D. Schneid, Disaster Management and Preparedness" Tata McGraw Hill , New Delhi, 2001 .
- 9.Vinod K. Jain , Earth Science, CBS Publishers and Distributors, New Delhi, 2005.

15GEOU03N1	APPLIED GEOLOGY	Credit - 4
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Objectives: Geology is the study of earth as a whole. The student is introduced to the general geology, structural geology, crystallography, mineralogy, palaeontology, stratigraphy, petrology, economic geology and applied geology, which constitute main components of geology. The topics chosen a working knowledge of geology for better understanding of earth's complex nature, nature, it's internal and external of present and past. The teaching and learning methodology involves class lectures and practical's / laboratory classes.

Unit	Lecture Content	Lecture Hours	No. of Lecture Hours
I	PHYSICAL GEOLOGY: Geology in Civil engineering – Branches of geology	1	10
	➤ structure of Earth and its composition	1	
	➤ Weathering of rocks – Scale of Weathering – Soils	2	
	➤ Landforms and processes associated with river, wind, groundwater and sea – relevance to Civil Engineering	3	
	➤ Plate tectonics – Earthquakes – Seismic zones in India	2	
	➤ Earthquake resistant buildings – design and construction	1	
II	STRUCTURAL GEOLOGY AND GEOPHYSICAL METHODS:	1	10
	➤ Geological maps – Attitude of beds	3	
	➤ Study of Structures – Folds, Faults and Joints – Relevance to Civil Engineering	3	
	➤ Geophysical methods – Seismic and electrical methods for subsurface investigations	3	
III	MINERALOGY AND PETROLOGY	1	10
	➤ Definition of mineral. Physical properties of minerals	1	
	➤ Physical properties of important rock forming minerals - Quartz, Feldspar, Mica, Pyroxene, Amphibole, Olivine, Garnet, Epidote and Beryl.	1	
	➤ Rocks and its Classification.	1	
	➤ Mode of formation of Igneous rocks. Chief forms of Igneous bodies	1	
	➤ Structures and Textures of Igneous Rocks	1	
	➤ Description of important Igneous Rocks: Granite, Syenite, Diorite, Obsidian, Pumice, Trachyte and Basalt.	1	
	➤ Sedimentary Rocks – Mode of formation and classification	1	
	➤ Description of important Sedimentary Rocks: Sandstone, Shale, Limestone and Laterite	1	
	➤ Metamorphic Rocks – Mode of formation	1	
➤ Important Rocks- Slate, Phyllite, Schist, Gneiss, Marble and Charnockite.	1		

IV	HYDROGEOLOGY AND ENGINEERING GEOLOGY: Hydrological cycle	2	10
	➤Origin and occurrence of Groundwater	2	
	➤Vertical distribution of Groundwater	2	
	➤Hydrogeological properties of rocks – Porosity, Permeability	2	
	➤Aquifer and its types, Aquifuge, Aquiclude and Aquitard.	2	
V	ROLE OF GEOLOGY IN CIVIL ENGINEERING		10
	➤Site investigating technics for Civil Engineering Projects	1	
	➤Remote sensing and GIS for Civil Engineering Applications	2	
	➤Geological conditions necessary for Design and Construction of Dams and Reservoirs	1	
	➤Geological conditions necessary for Design and Construction of Tunnels and Road cuttings	1	
	➤Hydrogeological Investigations and Mining	2	
	➤Coastal protection structures	1	
	➤Investigation of Landslides, causes and Mitigation	1	
➤Methods of improvement of sites	1		

Specific Outcome of Learning:

At the end of the course students will be able to,

1. Describe the importance of Geology in Civil Engineering
2. Assess the role of structural features and rocks in civil constructions
3. Describe the different types of minerals and rocks
4. Predict the natural disasters to prevent failure of Civil Projects
5. Describe the investigating techniques for site selection

Text Book

1. Venkat Reddy, Engineering Geology: Vikas Publishing, 2013.
2. Parbin Singh, Engineering Geology, S.K. Kataria & Sons, 2013.

Reference Book

1. Panday, H. K., Engineering Geology: Mc Graw Hill Education, New Delhi, 2014.
2. Garg, S.K., Physical and Engineering Geology: Khanna Publishers, 2012.
3. Krynine and Judd, Principles of Engineering Geology and Geotechnics: CBS publication, 2005.

15GEOP02N1	INTRODUCTION TO GEOSCIENCE	Credit - 4
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Objectives: *Geology is the study of earth as a whole. The student is introduced to the general geology, structural geology, crystallography, mineralogy, palaeontology, stratigraphy, petrology, economic geology and applied geology, which constitute main components of geology. The topics chosen a working knowledge of geology for better understanding of earth's complex nature, nature, it's internal and external of present and past. The teaching and learning methodology involves class lectures and practical's/laboratory classes.*

Unit	Lecture Content	Lecture Hours	Total Lecture Hours / Unit
I.	➤General Geology and Structural Geology: Definition, scope and branches of Geology.	1	12
	➤Origin of solar system: Nebular and Planetesimal hypotheses.	2	
	➤Brief description of earth's interior and the determination of age.	1	
	➤Outline of plate tectonics, earthquakes, volcanoes and tsunami.	2	
	➤Definition of Structural Geology. Concept of rock outcrop - dip and strike of rock formations.	2	
	➤Definition, parts and important types of a fold and fault.	2	
	➤Brief outline of joints and unconformities.	2	
II.	➤Crystallography and Mineralogy: Definition of Crystallography and crystals.	1	12
	➤Morphological characters of crystals: faces – forms – edges.	1	
	➤symmetry elements of crystals.	2	
	➤Miller's Indices.	2	
	➤Brief account on crystal systems.	1	
	➤Definition of mineralogy and mineral. Outline of physical properties of minerals.	1	
	➤Brief description of the Quartz, Feldspar, Pyroxene,	1	
	➤Amphibole, Mica group minerals.	2	
➤Description of the following minerals: Topaz- Olivine – Serpentine – Talc. Tourmaline – Beryl – Apatite – Corundum. Garnet – Diamond. Garnet – Beryl – Topaz – Apatite – Staurolite– Sillimanite – Epidote – Tourmaline - Corundum – Diamond.	3		
III.	➤Paleontology and Stratigraphy: Definition and importance of Paleontology and fossils.	1	

	➤Outlines of modes of preservation of fossils.	1	13
	➤Cephalopods.	1	
	➤Brachiopods.	1	
	➤Corals	1	
	➤Trilobites.	1	
	➤Definition and scope of Stratigraphy. Outline of	1	
	➤Geological Time Scale.	1	
	➤Brief account of the following geological formations in India: Dharwar Group,	1	
	➤Cuddapah Group.	1	
	➤Vindhyan Group.	1	
	➤Gondwana Group.	1	
	➤Cretaceous formations of Tiruchirapalli.	1	
IV.	➤Petrology and Economic Geology: Definition of Petrology and rock types.	1	12
	➤Important forms, structure and types of igneous, sedimentary and metamorphic rocks.	2	
	➤Brief description of the following igneous rocks: granite, syenite, pegmatite, aplite, gabbro, dolerite, and basalt.	1	
	➤Brief description of the following sedimentary rocks: sandstone, shale, and limestone.	1	
	➤Agents of metamorphism.	1	
	➤Brief description of the following metamorphic rocks: slate, phyllite, schist, gneiss, marble, quartzite, granulite, charnockite.	2	
	➤Definition of Economic Geology .An outline of the processes of ore formation.	1	
	➤Brief description of the physical properties and ➤Indian occurrences of the important ores, minerals rocks used for various purposes.	1	
	➤Coal Petroleum-composition, types and origin.	1	
	➤Occurrence coal and petroleum deposits in India.	1	
V.	➤Applied Geology: Introduction to geochemistry and geophysics.	2	12
	➤Principles of chemistry and physics applied to geology.	2	
	➤Outline of geochemical and geophysical methods used for exploring the earth.	2	
	➤Brief introduction about Nuclear Geology, Hydrogeology, Mining Geology, Engineering Geology and Environmental geology.	3	
	➤Introduction and application of remote sensing and Geographic Information System.	3	

Specific outcome of Learning:

The student gains an introduction to Geology and its usefulness in their major discipline.

Text Book:

- 1.Parbin Singh, B., A Textbook of Engineering and General Geology S.K.Kataria & Sons, Delhi. 2005.
2. Mukherjee, P.K., A Textbook of Geology. World Press, Kolkata. 1984.

Reference Book:

- 1.Mahapatra, G.B. General Geology. CBS Publishers, Delhi. 2000.
- 2.Bangar, K.M., Principles of Engineering Geology, CBS Publishers, Delhi.2009
- 3.Jain P.C and Anatharaman M.S., Palaeontology, Vishal Publishers. 2010.

15GEOP02N2	MEDICAL GEOLOGY	Credit - 4
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Objectives: Medical Geology and Geos sanitation are the application of geology to different life systems and landform systems and their management. The teaching and learning methodology involves class lectures, practical and laboratory demonstrations.

Unit	Lecture Content	Lecture Hours	Total Lecture Hours / Unit
I.	➤ Medical geology and Geo-chemistry Medical Geology: Introduction- - Traditional terrain classification – (Kurinji- Mullai- Marutham- Neithal- Paalai).- Exposure to environment.	1	9
	➤ Terrain based Nutritional Practices: Terrain and Food Sources. Food as medicine- Home remedies.	2	
	➤ Geo-chemistry Chemical elements of Earth - Major elements- Trace elements- Trace contaminants with no known functions – Toxicities & Deficiency mapping	2	
	➤ Geo-demography Settlement GIS- Pressure on natural resources- Pollution mapping.	2	
	➤ Geological factors in culture & civilization Terrain based Behavioral studies of Animals and Humans- - Time zone- Geological Time Scale – and human longevity.	2	
II.	➤ Earth Science and Occupational Health : ➤ Geo-medicine – GIS application-Disease mapping – Health GIS.	2	2
	➤ Geo-Epidemiology Epidemiological methods- GIS applications.	2	
	➤ Geo- entomology: Geo entomological factors in Public health issues – Mosquito.	2	
	➤ Occupational hazards Prevention of occupational diseases in mining industry	2	
	➤ GIS in health planning and management Health care of the community	2	
	➤ Earth Science and Occupational Health : ➤ Geo-medicine – GIS application-Disease mapping – Health GIS.	2	
	➤ Geo-Epidemiology Epidemiological methods- GIS applications.	2	
III.	Geo sanitation and Environmental Health :	2	
	➤ Water GIS: Planning and distribution.	2	
	➤ Water Quality Criteria & Standards	2	
	➤ Sanitation GIS - Waste management, Wealth from the waste models.	2	
	➤ Toilet GIS Terrain based Toilet construction and design in special situation - Community latrines management.	2	
	➤ Pollution mapping: Health issues of different type of pollution.	1	

IV.	➤Disaster management and First aid services: Type of Disaster and Consequences: Public health issues of disasters.	2	9
	➤First aid medicines and First aid Kit: List of medicines in “First Aid Kit”	2	
	➤Basic human ailments: Management of Emergency Problems	2	
	➤Geo-psychiatry: Disaster related Depression - Suicides-Emotional Stress – Alcoholism – Need for counseling.	2	
	➤Disaster preparedness and mitigation : Mobilizing all resources	1	
V.	➤Geophysics and Climate change: Geological factors on the Human systems.	2	9
	➤Geo genomics: Soil and Geobotanical plants and human health. Genetic Breeding and diversity.	2	
	➤Sleep Medicine: Earth rotation and Biological clock (Ageing).	2	
	➤Geo spirituality: Yoga and sustainable Earth, Benefits of “Pilgrimage Tourism”.	1	
	➤Geoculture and WHO – International health and World Health Organisation. Challenges in Global governance of health.	2	

Specific outcome of Learning: *The student gains useful insight into Remote Sensing and GIS which may be useful for both competitive exams and job prospects related to mineral and oil exploration industries.*

Reference Book

1. David Werner et al., “Where there is no doctor”, Reprinted, Macmillan, 1993.
2. Singh, R.Y., Geography of settlement, Reprinted, Rawat publications, 2007.
3. Purohit, N.J., Earth Science, Geology (Environmental and the Universe), 1st Edition, 2014, Swastik Publications, New Delhi, India
4. Gurugnanam, B., Essential of Hydrology, 2009, New India publishing agency, New Delhi, India.
5. Pradeep kumar, A.P. et al., Disaster risk and Vulnerability conference, 24-26 April 2014, Proceedings of the 2nd DRVC.
6. Skinner C.H and Berfer R.A., Geology and Health, 2000, Oxford University Press.
7. Selinus (Ed), Essentials of Medical Geology, Elsevier, 2000.
8. Gurugnanam, B., Geographical Information System, New India Publishing, 2009.
9. Anji Reddy, Textbook of Remote Sensing and Geographical Information System, 3rd edition, BS publication, 2010.