M.Sc., Applied Geology and Geomatics

Syllabus

w.e.f. 2018 Onwards

Centre for Applied Geology

Gandhigram Rural Institute (Deemed to be University)

SCHEME OF EXAMINATIONS
FIRST SEMESTER

Course Code	Paper Title	C	Hours			CFA	ESE	Total
			L/T	P	E			
18GEOP0101	Physical Geology and Geomorphology	3	3	-	3	40	60	100
18GEOP0102	Structural Geology, Geotectonics and Palaeontology	4	4	-	3	40	60	100
18GEOP0103	Stratigraphy and Indian Geology	4	4	-	3	40	60	100
18GEOP0104	Crystallography, Mineralogy and Gemmology	4	4	-	3	40	60	100
18GEOP0105	Remote Sensing and GPS	3	3	-	3	40	60	100
18GEOP0106	Crystallography and Mineralogy - Practical I	2	-	4	3	60	40	100
18GEOP0107	Structural Geology, Paleontology and Remote sensing - Practical II	2	-	4	3	60	40	100
18GTPP0001	Gandhi in Everyday Life	2	2	-	-	50	-	50
	Semester Total Credits	**24**						

SECOND SEMESTER

Course Code	Paper Title	C	Hours			CFA	ESE	Total
			L/T	P	E			
18GEOP0208	Igneous and Metamorphic Petrology	4	3	-	3	40	60	100
18GEOP0209	Economic Geology, Mineral Economics and Mining Geology	3	3	-	3	40	60	100
18GEOP0210	Environmental Geology and Natural Disaster Management	3	3	-	3	40	60	100
18GEOP0211	Digital Image Processing and Geocomputing	4	4		3	40	60	100
	Non-Major Elective	4	4	-	3	40	60	100
18GEOP0212	Igneous and Metamorphic Petrology and Economic Geology -Practical III	2	-	4	4	60	40	100
18GEOP0213	Digital Image Processing - Practical IV	2	-	4	4	60	40	100
18ENGP00C1	Communication and Soft Skills	2	2	-	-	50	-	50
Semester Total Credits		**24**						

THIRD SEMESTER

CourseCode	Paper Title	C	Hours			CFA	ESE	Total
			L/T	P	E			
18GEOP0314	Sedimentary Petrology and Marine Geology	3	3	-	3	40	60	100
18GEOP0315	Hydrogeology and Engineering Geology	4	4	-	3	40	60	100
18GEOP0316	Geophysics and Geochemistry	3	3	-	3	40	60	100
18GEOP03EX	Major Elective	4	4	-	3	40	60	100
18GEOP0317	Geophysics, Geochemistry Hydrogeology and Sedimentology - Practical - V	2	-	4	4	60	40	100
18GEOP0318	Geographic Information System, and GPS – Practical VI	2	-	4	4	60	40	100
18GEOP03MX	Modular Course	2	2	-	-	50	-	50
18EXNP03V1	Village Placement Programme	2	-	-	-	40	60	100
18GEOP03F1	Geological Field Study	2	-	-	-	50	-	50
Semester Total Credits		**24**						

FOURTH SEMESTER

Course Code	Course Title	C	Hours			CFA	ESE	Total
			L /T	P	E			
18GEOP0419	Petroleum Geology, Coal Geology and Geothermal Resources	4	4	-	3	40	60	100
18GEOP02MX	Modular Course	2	2	-	-	50	-	50
18GEOP04F1	Geological Field Study II	2	-	-	-	50	-	50
18GEOP0420	Dissertation	8				75	75*+50**	
	Total	**16**						

*Evaluation by External Examiner

**Evaluation by External and Internal Examiner

Major Electives
18GEOP03E1 - Experimental Petrology
18GEOP03E2 -Advanced Ore Geology
18GEOP03E3-Geographic Information System and Geocomputing

Modular Courses	
18GEOP03M1 – Medical Geology	15GGMP02MX
18GEOP03M2 –Micropaleontology	
18GEOP04M1 - Geostatistics	15GGMP03MX
18GEOP04M2 - Advanced Hydrogeology	

Courses Offered from Centre for Applied Geology							
Course Code	**Paper Title**	**L /T**	**P**	**E**	**CFA**	**ESE**	**C**
18GEOP02N1	Introduction to Geoscience	4		3	40	60	4
18GEOP02N2	Medical Geology	4		3	40	60	4
18GEOP02N3	Environmental Geosciences	4		3	40	60	4
18GEOP02N4	Disaster Management	4		3	40	60	4

Abstract - Credits

Course	**Sem. – I Credits**		**Sem. – II Credits**		**Sem. – III Credits**		**Sem. – IV Credits**
	T	**P**	**T**	**P**	**T**	**P**	**T+D**
Core Papers	18	4	12	4	16	4	4 + 8
Non-Major Elective			4				
Major Elective					4		
Modular Course					2		2
Extension / Field Study					2		2
Total	**24**		**24**		**24**		**16**

Course Syllabus

Course Code & Title	18GEOP0101 Physical Geology and Geomorphology		
Class	M. Sc Geology and Geomatics	**Semester**	1st Semester
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To Learn about the Origin of the Earth, Interior structure of Earth, atmosphere, Hydrosphere, Lithosphere, and various geological processes acting on Earth • To Understand the natural processes which act on the earth' s surface and the landforms. • To Build knowledge about the landforms formed due to tectonic activity. • To Demonstrate about the Coastal geomorphic features and its associated landforms • To Illustrate about the volcanic landforms.		

Unit	Content	No. of Hours
I	**Solar System;** ***Origin of the Earth*****;** Nebular Hypothesis, Planetismeal Hypothesis, Gaseous Tidal Hypothesis. Binary star Hypothesis. **Age of the Earth;** Direct and Indirect Methods. ***Interior of the Earth*****. Atmosphere, Hydrosphere, Lithosphere and their Constituents. Geological Process;** Endogenic Process and Exogenic Process. ***Earthquakes***: Seismic waves, Origin, Classification and Causes of Earthquake, Earthquake Intensity Scale; **Volcanoes:** Structure, Classification and Products of Volcanoes. Isostasy, Continental Drift, Paleomagnetism, ***Plate Tectonics***, Convection current hypothesis, Sea Floor spreading.	9 Lectures
II	**Fundamental Concepts of Geomorphology; Geomorphic Processes;** Exogenetic and Endogenic processes. ***Weathering*****;** Physical weatheiring, Chemical Weathering, Biological Weathering. **Soil Processes;** Soil Profile, Climate and Soil Formation, Soil Types. **Mass Wasting;** Soil Creep and Solifluction, Earth and Mud Flows and Slides**. Karst Topography**.	9 Lectures
III	**Tectonic Geomorphology;** Topography on Dome and Folded Structures, Topography upon Faulted Structures. ***Fluvial Geomorphology*****;** Stream Erosion, Stream Transportation and Deposition, Features of Stream Erosion, ***Depositional Landforms***, **Drainage Systems,** Types of Streams and Stages of Valley Development.	9 Lectures

IV	**Coastal Geomorphology:** Shorelines; Classification of Coast and shoreline; Johnson's Classification of shorelines, Shepard's Classification of coast, Davies Classification. Shoreline Erosional Features, Transportation by Sea, Deposition by Sea. ***Features of Ocean basin floor*** (Mid Ocean Ridge, Deep Ocean Trenches, Abyssal Plains, Sea Mounts). **Coral Reefs**. **Aeolian Geomorphology;** Wind Erosion, Erosional Features, Wind Transport, Wind Deposits. Types of Sand Dunes. Loess.	9 Lectures
V	**Volcanic Geomorphology:** Types of Eruption, Features of Lava fields, Features Associated with Volcanoes; Ash Showers, Volcanic Mudflows or Lahars, Plug Domes. **Depression Forms;** Craters, Calderas, Volcanic Tectonic Depression. **Volcanic Plateaus and Plains. Glacial Geomorphology:** Types of Glaciers, Movement of Glaciers, Glacial Erosion, Transport by Glaciers, Glacial Deposits. **Geomorphology of India;** Peninsular, Extra Peninsular, Indo Gangatic Plain.	9 Lectures
References	**Text Books:** 1. Alka Gautam (2009), Geomorphology, First Edition: Sharada Pustak Bhawan 2. Allen Cox (1973), Plate Tectonics, Freeman and Company. 3. Radhakrishnan. V (1987), Physical Geology, VV.P. Publishers. 4. Savindra Singh, (2012) Geomorphology, Fifth Edition: Pyayag Pustak Bhawan. 5. Thornbury, W.D., (2002) Principles of Geomorphology, John Wiley and Sons, 2nd Edition, New York. **Reference Books:** 1. Bloom, A. (2005) Geomorphology. Pearson. New Delhi. 2. Gupta, R.P (2003) Remote Sensing Geology, Springer - Verlag - New York, London. 3. Hamilton, E. I. (1965) Applied Geomorphology. Academic Press. 4. Holmes, A. (1965) Principles of Physical Geology. Ronald. 5. Jha, V.C., (2001) Geomorphology and Remote Sensing, ACB Publications. 6. Sharma, H. S. (1990) Indian Geomorphology. Concept Publishing Co., New Delhi. **Web resources:** 1. *Underlined Titles are available at Swayam portal* 2. *https://www.nap.edu/read/12700/chapter/3#17* 3. *https://www.usu.edu/geo/liddell/oceans/oc-ppts/ocpptxt_10.pdf*	
Course Outcomes	On completion of Course, the students should be able to 1. Explain the Origin, Age and Interior of the Earth, Earthquake and Volcanoes, Isostasy, Continental Drift and Plate Tectonics. 2. Describe the Fundamental concepts of Geomorphology, Weathering, Soil processes and Karst Topography. 3. Discuss the geological structures formed by the Tectonic activities and the geological work done by a river and the various drainage systems. 4. Describe the coastal process along the shore line on the surface of the earth and the geological work done by wind. 5. Explain the volcanic and glacial processes acting on the surface of the earth and its resultant surface morphology.	

Physical Geology and Geomorphology												
CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	1	1	2	2	1	2	3	2	2	2	1
CO2	3	1	1	2	2	1	2	3	2	3	2	1
CO3	3	1	1	2	2	1	2	3	3	3	2	1
CO4	3	1	1	2	2	1	2	3	3	3	2	1
CO5	3	1	1	2	2	1	1	3	2	2	2	1

Course Code & Title	18GEOP0102 Structural Geology, Geotectonics and Paleontology		
Class	M.Sc Geology and Geomatics	**Semester**	1st Semester
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To introduce students about the basic principles, methods and characteristics of Structural geology, concepts of Stress and strain, deformation, types of folds. • To gain knowledge about the origin, mechanism and characteristics of various types of faults and joints • To describe in detail about the geotectonic and tectonic framework of India. • To know the past life and history the study of the Earth through remains of animals and plants entombed within the rocks • To study in detail about the paleobotany and microfossils.		

Unit	Content	No. of Hours
I	**Structural Geology:** Objectives of Structural Geology **- *Deformation Mechanisms***: Mechanical Properties of rocks - Concepts and types of Stress and Strain. Strain Rate, Elastic, Ductile and Brittle Deformation - Mohr's circle - types of stress ellipsoid and their geological significance - strain analyses of naturally deformed rocks - Stereographic Projections and Stereogram - **Cleavage and Schistosity**: Introduction, Slaty cleave or schistosity, Fracture cleavage, Shear cleavage, Slip cleavage, Bedding cleavage, Axial plane cleavage. ***Foliation*:** Primary and secondary foliation. ***Lineation***: Definition and kinds of lineation: Slickenside, Boudinage, Quartz rods, Mullion structure. ***Folds: Mechanism of Folding*:** Introduction - Types of folding- Causes of folding**: Tectonic process - Non-tectonic process.** Depressions and Culminations - Domes and Saddles - Profile of a Fold – **Recognition of Folds in the field and map.**	12 Lectures
II	**Fault:** ***Mechanism of faults*:** Introduction - Description and classification of faulting - Criteria for faulting. **Normal faults** - representation of normal faults on the block diagram's - reverse faults and thrust faults - Stratigraphic differences between normal and reverse faults - Nappe, klippe and tectonic window - flat and steeps of the reverse faults - autochthonous and allochthonous units - imbricate and dublex structures - horst and graben - Strike-slip faults and minor structures associated with such faults -	12 Lectures

	cataclastics and mylonites - Anderson's theory of faulting - Recognition of Faults in the field and map - ***Joints*****:** Geometry - Field studies - Principles of Failure by rupture - Relation of rupture to stress and strain - Genetic classification of joints - Recognition of Joints in the field and map.	
III	***Unconformity*****:** Introduction - Kinds of Unconformities - Recognition of Unconformities - Distinguishing Faults from Unconformities - Radiogenic dating - Tectonism and sedimentation**.** Diapirs and Salt Domes - Recognition of Unconformity in the field and map. **Lineament:** Mapping and Analysis - Basin Tectonics - Microstructures and Structures of Sedimentation and Intrusion- Structural analyses - **Principle and elements of Structural Analyses** - Geometrical Analyses of simple and complex structure on mesoscopic and macroscopic scale. **Geotectonics:** Tectonic features of the Earth - Continental drift – Sea floor spreading - Plate Tectonics –Elements of Tectonism - Characteristics of Plates - World Plates - Plate Boundaries - Assumptions and Problems - causes and mechanism - Convection - **Plate Tectonics and Mineral Deposits** - Geosynclines – Types – Classification and Origin - Concept of Isostasy - Orogeny & Epiorogeny – Seismic Belts of the Earth – Seismicity and Plate Movements - **Tectonic Frame Work of India**	12 Lectures
IV	***Paleontology: Brief out line of Geological time scale*** and Life through Ages - Fossils and Their Modes of Preservation - Origin and Evolution of life – Recent Theories - Species concepts – Phylogeny- Antogeny – Palingenesis - Invertebrate **Paleontology:** Morphology, Evolutionary Trends, Stratigraphic importance and application of: ***Trilobites - Graptolites – Corals – Brachiopods - Cephalopods.***	12 Lectures
V	**Vertebrate Paleontology**: Classification of Vertebrates – Study of evolution of Horse - Elephant and Man - Extinction of Dinosaurs. **Palaeobotany:** ***Methods of preservation of fossil plants*** - Objective and limitation of fossil Plants – Classification. **Micropaleontology:** Definition and Applications of Micropaleontology – Field and laboratory techniques of micropaleontology - Types of Microfossils - Foraminifers and Ostracods – General Morphological Characters - Classification.	12 Lectures
References	**Text Books:** 1. Billings, M. P., Structural Geology, III edition, Prentice-Hall, Inc., New Jersey, USA, 2008. 2. Condie, K.C., Plate Tectonics & Crustal Evolution, 4th Edition, Butterworth-Heinemann, Boston, 2003. 3. Henry Woods, (2005) Paleontology Invertebrate, The University Press. **Reference Books:** 1. David M. Raupsteven, M., Stanley, Principles of Paleontology, New Delhi, 2004. 2. Davis, G.H., And S.J., Renolds, Structural Geology of Rocks and Regions, 2nd Ed., Wiley, Newyork, 1996. 3. Gokhale N W, Theory of Structural Geology, CBS Publications, 2009. 4. Hobbs, B. E., Means, W. D., & Williams, P. E., An Outline of Structural Geology, John Wiley & Sons, Inc, Australia, 1976. 5. Jain, P.C and Anantharaman, M.S., Paleontology: Evolution and Animal Distribution, 6th Edition, Vishal Publishing Co, New Delhi, 2005. 6. Moore, R.C, Lalicker, C.G & Fisher, A.G., Invertebrate Fossils, 1st Indian Edition, CBS Publishers & Distributors, New Delhi, 1997. 7. Park, R.G, Foundation of Structural Geology, Blackie And Sons Ltd., Glasgow, New	

	Zealand, Second Edition, 1989. 8. Raup And Stanely, Principles of Paleontology, CBS, 2004. 9. Shrock & Twenhofel, Principles of Invertebrate Paleontology, CBS Publishers & Distributors, New Delhi, 2005. **Web resources:** *1. Underlined Titles are available at Swayam portal* *2. http://geologylearn.blogspot.com/2015/08/deformation-mechanisms-and.html* *3. http://www.yourarticlelibrary.com/geology/rocks/rock-cleavage-meaning-types-and-importance-geology/91506* *4. https://flexiblelearning.auckland.ac.nz/rocks_minerals/rocks/schist.html* *5. https://www.britannica.com/science/foliation-geology* *6. http://geologylearn.blogspot.com/2015/08/folding-mechanisms-and-processes.html* *7. http://eqseis.geosc.psu.edu/~cammon/HTML/Classes/IntroQuakes/Notes/faults.html* *8. http://www.indiana.edu/~geol105b/images/gaia_chapter_6/unconformities.html* *9. http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000448GO/P000596/M018266/ET/1482317287MAINTEXT.pdf* *10. https://sciencing.com/types-fossil-preservation-5413212.html* 11. *http://osp.mans.edu.eg/abuzied/Micropaleontology.html.*
Course Outcomes	On completion of Course, the students should be able to 1. Predict the various forces acting in the earth's and its resultant structural changes. The Geometry, Types and Mechanism of Folding 2. Explain 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 Paleontological Techniques. 5. Outline of vertebrate paleontology and micropaleontology.

18GEOP0102
Structural Geology, Geotectonic and Paleontology

CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	1	1	2	1	0	1	3	2	2	1	0
CO2	3	1	1	2	2	1	2	3	2	2	2	1
CO3	3	1	2	2	2	1	2	3	1	2	2	1
CO4	3	1	2	1	2	1	1	3	2	2	2	1
CO5	3	1	1	2	2	1	1	3	1	2	2	1

Course Code & Title	18GEOP0103 Stratigraphy and Indian geology		
Class	M.Sc Geology and Geomatics	**Semester**	1st Semester
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To Introduce the students about the basic principles of stratigraphy, its classification, Geologic timescale and various types of correlation. • To Learn about the origin and significance Indian Stratigraphy • To Gain knowledge about the Cambrian system, Gondwana System, and Cretaceous System. • To Understand about the Siwalik System and Deccan traps • To Describe in detail about the boundary and age problem.		

Unit	Content	No. of Hours
I	**Stratigraphy:** Principles and Classification of Stratigraphy– Litho-, Bio-, chrono-, Magneto stratigraphy and their Applications– **Elements of** – Cyclostratigraphy, Allo-, Pedo-, Chemo- and Seismic Stratigraphy. Basic ideas of ***Sequence stratigraphy*** and Quaternary Stratigraphy. Bouma sequence – Geological Time Scale and Indian Time Scale, Paleogeography and life of each period. ***Correlation***: Physical and paleontological correlation method – Homotaxic, Contemporaneity and Syntaxis, Lateral variation and facies– code of stratigraphic nomenclature. Stratotypes and its requirements.	12 Lectures
II	***Indian Stratigraphy*****:** Stratigraphic Distribution, Geological Succession, Structure, Tectonics and **Economic Importance of the following**; – Archaean system –Cuddapah system –Kurnool system – Vindhyan system – ***Aravalli system of India***, Dharwar system– Sargur Supergroup, Sakoli Group – Sausar Group – Iron ore Group of Bihar and Orissa – Bundelkhand Group – Banded Gneiss complex, The Paleozoic Group.	12 Lectures
III	**Distribution - Classification - Structure - Correlation - Sedimentation - Fossils - Paleogeography and Economic importance** of Cambrian to Lower Carboniferous systems- Gondwana Group, Triassic of Spiti, Jurassic of Kutch, Cretaceous of Trichinopoly and the marine Cretaceous system	12 Lectures
	Distribution: Structure, Lithology, Climate, Fossils and Origin of - Siwalik system, Pleistocene-Holocene system, Quaternary glaciations, Rise of	12 Lectures

IV	Himalayas - Eocene, Oligocene and Lower Miocene systems. ***Deccan Traps***: Distribution - Classification - Structure - Geological Succession – Inter-Trappean and Infra-Trappean beds- Bagh Beds, – Origin- Economic importance - Lameta beds - Age and Economic importance.	
V	**Boundary and Age Problems**- K-T boundary problem, Precambrian – Cambrian boundary problem, Permian - Triassic boundary problem, Age of Saline Series, Age of Deccan traps, World stratigraphy**:** Brief description of the principle, stratigraphic units of the world in type area.	13 Lectures
References	**Text Books:** 1. Krishnan, M.S. (2009), Geology of India and Burma, 6th Edition, CBS Publishers and distributors. 2. Parbin SINGH. (1978), Engineering & general geology, fourth edition 3. Wadia, (1893) Geology of India, McGraw Hill Book Co. **Reference Books:** 1. Boggs,S (1987). Principles of Sedimentology and Stratigraphy, Merill Publishing Co. New York. 2. Ravindra Kumar, (2010) Fundamentals of Historical Geology and Stratigraphy of India, New Age International (p) Ltd. 3. Weller. A.K. (1988) Principles of Stratigraphy. Asia Publishing House. Delhi. 4. Gignoux, M (1960) Stratigraphical Geology, Mc Graw hill publications. **Web resources:** *1. Underlined Titles are available at Swayam portal* *1. http://www.uh.edu/~geos6g/1330/strat.html* *2. http://www.geographynotes.com/rocks/the-gondwana-group-of-rocks-india-geology/5783* *3. https://www.gktoday.in/academy/article/indias-rock-formation-archean-dharwar-cudappah-vindhyan-gondwana-and-tertiary-rocks/* *4. https://www.gns.cri.nz/Home/Learning/Science-Topics/NZ-Geology/Measuring-Geological-Time* *5. http://www.stratigraphy.org/upload/bak/strats.htm* *6. https://en.wikipedia.org/wiki/Quaternary_glaciation* 7. *http://northpacificresearch.com/downloads/Problems_at_the_KT_Boundary.pdf*	
Course Outcomes	On completion of Course, the students should 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, The Paleozoic Group, The Tertiary Group **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.	

18GEOP0103
Stratigraphy and Indian geology

CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	1	1	1	3	1	1	3	1	1	1	3
CO2	3	1	1	1	3	1	1	3	1	1	1	3
CO3	3	1	1	1	3	1	1	3	1	1	1	3
CO4	3	3	1	3	3	1	2	3	1	1	1	3
CO5	3	3	1	3	3	1	2	3	1	1	3	3

Course Code & Title	18GEOP0104 **CRYSTALLOGRAPHY, MINERALOGY AND GEMMOLOGY**		
Class	M.Sc Geology and Geomatics	**Semester**	1st Semester
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To Understand Crystal Symmetry and Atomic structure • To Learn about the optical properties of the minerals and its characteristics features. • to Describe in detail about the various mineral groups and its properties. • To Know about the rock forming silicates • To Study about the various Gem varieties and its properties.		

Unit	Content	No. of Hours
I	***Crystallography; Description of Six Major Crystal Systems***, **Unit Cells and Lattice;** Parameters and Crystallographic Axes. Points in Unit Cell, Plains in Crystals. Crystal Forms and Miller Index. **Derivation of 32 Class;** Concept of Space lattice – Derivation of 14 Bravais lattices **Concept of Space Group** – Symmorphic and Asymmorphic Space Groups- **Mineralogical investigations methods** -X- ray diffraction- Electron Probe Micro Analysis (EPMA), Scanning Electron Microscope (SEM), and Raman Spectroscopy.	12 Lectures
II	**Optical Mineralogy – Mineral Preparation for Microscopic study;** Types of Preparation, Materials for Thin Section, The Mineral Slice and Cutting. **Polarizing Microscope;** General Features, Parts of Microscope, Phase Microscopy and its Examination. Adjustment of Polarizing Microscope. **Plane polarized and cross polarized light; Isotropic and Anisotropic minerals;** Behavior of minerals in cross polarized light- Birefringence – Uniaxial minerals – **Uniaxial and Biaxial Indicatrices; Optical accessories like mica, gypsum and quartz plates – Determination of Optic sign**: uniaxial and biaxial minerals- Absorption of light by minerals – Scheme of pleochroism	12 Lectures
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- **Descriptive Mineralogy**; Mineral Groups: Chemical, Physical, Optical Properties of minerals.	12 Lectures

IV	Alteration products, paragenesis and modes of occurrences of the following rock forming silicates. ***Neso silicates***: Olivine group, Garnet group- ***Sorosilicate***: Epidote group – Beryl. ***Ring Silicates*:** Tourmaline –Benitoite- ***Chain Silicates*:** Pyroxene group- Amphibole group and Wollastonite- ***Sheet Silicates*:** Mica group- Chlorite group- ***Tectosilicates*:** Quartz -Feldspar group- Feldspathoid group- Zeolite and Scapolite groups.	12 Lectures
V	**Gemmology:** Physical characteristics (including electrical, thermal and magnetic characters) and chemical composition of gemstones. **Optical properties of Gemstones**- Classification of Gemstones - **Application of UV, X - rays and Infra-Red Rays in Gem Identification**. Synthetic gems – characteristics- Uses of gem stones.	13 Lectures
References	**Text Books:** 1. Dana, (1991) Textbook of Mineralogy, Fourth Edition, William E. Ford Edward Salisbury 2. Berry Mason, L.G, (1985), Elements of Mineralogy, Reprint, W.H. Freeman &Co. 3. Paul F. Kerr (1959), Optical Mineralogy- Third Edition. McGraw-hill book company. 4. Peter G. Read, (2005) Gemmology, Butterworth-Heineman **Reference Books:** 1. Deer, W. A., Howie, R.A & Zussman (2013), An Introduction to Rock forming Minerals, Third Edition, ELBS Ed. 2. Ernest E. Walhstrom, (1979) Optical Crystallography, John Wiley & Sons. 3. Perkins, (2010) Dexter Mineralogy,3rd Edition, Prentice Hall. 4. RavellPhillips, W.M. & Dana. T. Griffen, (2004), Optical Mineralogy-The Non-Opaque Minerals, CBS publishers & Distributors. 5. Mike Howard &Darcy Howard, (1998) Introduction to Crystallography and Mineral Crystal Systems, Rock hounding Arkansas. **Web resources**: 1. *Underlined Titles are available in Swayam portal* 2. *http://www.tulane.edu/~sanelson/eens211/#Lecture%20Notes* 3. *http://jaeger.earthsci.unimelb.edu.au/msandifo/Teaching/Mineralogy2/mineralogy.pdf* 4. *http://epgp.inflibnet.ac.in/ahl.php?csrno=448* 5. *https://www.researchgate.net/publication/221923612_An_Introduction_to_Mineralogy* 6. *http://www.minsocam.org/msa/openaccess_publications/McNamee_Gunter_Lab_Manual.pdf*	
Course Outcomes	On completion of Course, the students should be able to 1. Discuss about the Description of Six Major Crystal Systems, Unit Cells and Lattice, Derivation of 32 Class, Concept of Space Group, Mineralogical investigations methods 2. Demonstrate the Optical Mineralogy, Mineral Preparation for Microscopic study 3. Explain the Advanced Mineralogy, Descriptive Mineralogy 4. Describe about the Neso silicates, Sorosilicate's, Ring Silicates, Chain Silicates, Sheet Silicates, Tectosilicates 5. Discuss about the Gemmology and Application of UV	

CRYSTALLOGRAPHY, MINERALOGY AND GEMMOLOGY												
CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	1	1	2	2	1	2	3	1	1	2	2
CO2	3	2	1	2	2	1	2	3	1	1	2	1
CO3	3	1	1	2	2	1	2	3	1	1	2	2
CO4	3	1	1	1	1	1	2	3	1	1	2	1
CO5	3	1	1	1	1	1	2	3	1	1	2	2

Course Code & Title	18GEOP0105 **REMOTE SENSING AND GPS**		
Class	M.Sc Geology and Geomatics	**Semester**	1st Semester
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To Understand the principles and types of Remote sensing • To Know in detail how Electromagnetic Spectrum is related to the field of Remote sensing • To Introduce about the satellites and sensors and their characteristic features. • To Explain about the photo interpretation keys and elements in remote sensing data • To Illustrate about the principles and components of GPS		

Unit	Content	No. of Hours
I	**Remote Sensing** – An Introduction: History and Development of Remote Sensing, **Fundamental Principles of Remote Sensing-** Stages in Remote Sensing Process. **Types of Remote Sensing-** Advantages of Remote sensing, Aerial Photographs, Basics, Stereo models, Photo Mosaics and Photo scale.	9 Lectures
II	***The Electromagnetic Spectrum*-** Wave Model, Particle Theory, Electromagnetic Spectrum, Radiation Law and Related terms, Black Body Radiation, **Electro Magnetic Radiation (EMR):** EMR Spectrum – **EMR Interaction with Atmosphere**: Absorption, Scattering & Atmospheric windows.	9 Lectures
III	**Satellites and Sensors**- Platforms- Satellite Orbits: Geostationary, Sun synchronous Satellites- **Resolution:** Spatial Resolution, Spectral Resolution, Radiometric Resolution, Temporal Resolution, Multispectral Resolution. **Scanning Mechanisms:** Across Track Scanning**,** Along Track Scanning, Satellites in Orbits- Landsat Series, SPOT Series, Indian Remote Sensing Satellites, Quick bird Satellite, World View, Geo Eye, ASTER, MODIS, NOAA	9 Lectures
IV	***Photo Interpretation Keys & Elements***: Definition, parts, Key sets, Types of Study, **Photo Interpretation Elements** - Tone, Texture, Shadow, Size, Shape, Pattern and Association. **Geotechnical / Geomorphic Elements** - Landforms, Drainage, Erosional Pattern, Vegetative Cover, Landuse, Shape & size of objects, **Thermal Remote Sensing:** Basic concepts and Data Interpretation.	9 Lectures

	Microwave Remote Sensing: Basic concepts and Data Interpretation. **Hyperspectral Remote Sensing: *Basic concepts and Data Interpretation***.	
V	**GPS Basics:** Introduction – Satellite, Control and User Segments – Signal Components, Errors in GPS observations, PS positioning, Differential GPS. **GPS Mapping**: Conventional Static, Kinematic GPS Semi kinematic (Stop & Go) – Rapid static Mobile mapping.	9 Lectures
References	**Text Books:** 1. Underlined Titles are available in Swayam portal 2. Anji Reddy, M. (2012) Textbook of Remote Sensing & GIS, BS Publications, Hyderabad. 3. Curran, P (1985). Principles of Remote Sensing, Longman, London. 4. Sabins, F.F. (2007) Remote Sensing Principles and Interpretation, Freeman, Sanfrancisco. **Reference Books:** 1. John, T. Smith, Jr, (1973) Manual of Colour Aerial Photography (I Edition) American Society of Photogrammetry, ASP Falls Church, Virginia. 2. Lillesand, T.M. And Kiefer, P.W., (2007) Remote Sensing and Image Interpretation, John Wiley & Sons, New York. Third Edition. 3. Rampal, (1999) Handbook of Aerial Photography and Interpretation, Concept publishing. 4. Shiv N. Pandey, (1987) Principles and Applications of Photo geology, Wiley Eastern Limited, India. **Web resources:** 1. *http://www.gdmc.nl/oosterom/PoRSHyperlinked.pdf* 2. *http://www.geoservis.ftn.uns.ac.rs/downloads/ISP/1999-fundamentals-of-remote-sensing.pdf* 3. *https://webapps.itc.utwente.nl/librarywww/papers_2009/general/PrinciplesRemoteSensing.pdf*	
Course Outcomes	On completion of Course, the students should 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.	

REMOTE SENSING AND GPS												
CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	1	1	3	3	1	2	3	3	3	2	2
CO2	3	1	1	3	3	1	2	3	1	1	1	1
CO3	3	1	1	2	2	1	2	3	1	1	2	2
CO4	3	1	1	3	3	1	2	3	1	1	2	2
CO5	3	2	1	2	3	1	2	3	1	1	2	2

Course Code & Title	18GEOP0106 **CRYSTALLOGRAPHY AND MINERALOGY - PRACTICAL - I**		
Class	M. Sc Geology and Geomatics	**Semester**	1st Semester
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To Identify various crystal models • To Derive the Millerian Signs • To Determine the optical properties of minerals • To Discriminate the structural formulae for various mineral groups. • To Examine the megascopic properties of rock forming Minerals		

Unit	Contents
	1. Study of Crystal models of all crystal 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 co zonal quartette. 6. Determination of Optical Properties of Minerals using Petrological Microscope. 7. Determination of Relative Birefringence, order of interference colour, sign of elongation, birefringence, scheme of pleochroism and pleochroic formula. 8. Determination of Optic orientation, extinction angle, anorthite content. 9. Determination of structural formula of the following mineral groups: Garnet, Olivine, Pyroxene, Feldspar, Mica and Amphibole. 10. Megascopic Identification of Important Rock Forming Minerals.
Course Outcomes	On completion of Course, the students should be able to 1. Identify the physical properties of industrial minerals and Fe ores 2. Explain the physical properties of Cu and Mn ores. 3. Discuss the physical properties of Pb and Zn ores 4. Identify physical properties of Sn, As, Sb ores and radioactive ores 5. Analyze the Ore minerals quantitatively.

CRYSTALLOGRAPHY AND MINERALOGY - PRACTICAL - I												
CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	2	1	3	3	1	2	3	1	1	1	3
CO2	3	2	1	3	3	1	2	3	1	1	1	3
CO3	3	2	1	3	3	1	2	3	1	1	1	3
CO4	3	2	1	3	3	1	2	3	1	1	1	3
CO5	3	1	1	1	3	1	1	3	1	1	3	3

Course Code & Title	18GEOP0107 **STRUCTURAL GEOLOGY, PALAEONTOLOGY AND REMOTE SENSING - PRACTICAL - II**		
Class	M. Sc Geology and Geomatics	**Semester**	1st Semester
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To Identify the megascopic features and the morphological characteristics of Fossils. • To Determine the geological structures through cross sections. • To Identify the True dip, apparent dip, and thickness of Beds. • To visually interpret the images using stereoscopes • Interpret the lithology, structure, geomorphology, land use/ landcover through satellite imagery and aerial photographs.		

Unit	Contents
	1. Megascopic identification of Fossils. 2. Reconstruction of Broken Fossils. 3. Tracing Evolutionary trends in Trilobites, Graptolites, Cephalopods, Brachiopods and Corals. 4. Chronological Arrangement of Mega fossils. 5. Morphological study of Foraminifera. 6. Three-point problems for Fold maps, Fault maps, and Unconformity maps and Preparation of cross sections across the geological maps to bring out the structure and order of superposition of the beds. 7. Structural geology problems/Graphical determination of Dip in gradient. 8. Determination of True dip by simple calculation. 9. Determination of Apparent dips by Graphical method. 10. Determination of Thickness of bed by calculation on a level ground. 11. Geometric analyses of linear and planar features using Stereographic projection 12. Visual Interpretation Methods 13. Visual Interpretation Instruments – Mirror Stereoscope 14. Visual Interpretation Instruments –Pocket Stereoscope 15. Parallax Bar 16. Satellite Image interpretation Elements. 17. Lithology through aerial photograph and satellite data 18. Structure through aerial photograph and satellite data 19. Geomorphology through aerial photograph and satellite data 20. Landuse and Landcover aerial photograph and satellite data

	21. Spatial resolution vs Features 22. Lineament mapping and its measurements
Course Outcomes	On completion of Course, the students should be able to 1. Identify the megascopic fossils 2. Analyze the broken fossils 3. Explain the Morphological features of fossils 4. Assess the Dip and strike from the maps 5. Analyze the thickness of beds by calculation method

STRUCTURAL GEOLOGY, PALAEONTOLOGY AND REMOTE SENSING - PRACTICAL - II												
CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	1	1	1	3	1	1	3	1	1	1	3
CO2	3	1	1	1	3	1	1	3	1	1	1	3
CO3	3	1	1	1	3	1	1	3	1	1	1	3
CO4	3	3	1	3	3	1	2	3	1	1	1	3
CO5	3	3	1	3	3	1	2	3	1	1	3	3

Course Code & Title	18GEOP0208 **IGNEOUS AND METAMORPHIC PETROLOGY**		
Class	M.Sc Geology and Geomatics	**Semester**	2nd Semester
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	The course aims • To Learn about the composition of Magma, crystallization of magma • To Understand the classification of Igneous rocks • To Gain knowledge about the petrography of various types of Igneous rocks. • To Know about the formation and different facies of Metamorphism • To Describe petrography of metamorphic rocks.		

Unit	Content	No. of Hours
I	**Igneous Petrology**: Composition and Constitution of Magmas – Phase rule Bowen's Reaction Principle - **Reaction principles in petrogenesis** – continuous and discontinuous series. ***Crystallization of Unicomponent Magma, Binary Magma*** (Diopside - Anorthite, Forsterite – Silica and Albite - Anorthite). ***Ternary Magma*** (Albite - Anorthite - Diopside, Forsterite - Anorthite-Silica, Diopside – Forsterite -Anorthite). Outline of Quaternary System for Basalt. Crystallization of Basaltic Magma. Magmatic Crystallization, Differentiation-Assimilation.	12 Lectures
II	***Classification of Igneous rocks*** – Chemical classification- CIPW Norm, Silica saturation and Alumina saturation**. -** Tyrrell's tabular Classification. IUGS classifications. **-**Types of Variation diagrams and their utility**– Petrography-**A detailed Petrography of Acid and Intermediate Igneous rocks and their volcanic equivalents. **-** A detailed Petrography of Basic and Ultra basic Igneous Rocks and their volcanic equivalents.	12 Lectures
III	**Petrography of Rocks**-Anorthosites, Pegmatites, Carbonatites, Lamprophyres, Granites, and Kimberlite. **Igneous rocks at Continental margins:** The Ophiolite suite. Calc alkaline and Tholeilite group of rocks. **The Origin of Igneous rocks –** variations in igneous rock, Evidence of Differentiation, Variation within a single rock body.	12 Lectures

IV	**Metamorphic Petrology:** Definition, Agents and types of Metamorphism, ***Facies and Grades of Metamorphism***. Texture and Structures of Metamorphic rocks. Metamorphic rock types. Mineralogical phase rule of close and open systems. **Mineral assemblages and metamorphic reactions**. P-T conditions of metamorphism. **Laws of Thermodynamics**- Gibbs free energy. Concept of Activity, Fugacity, Ideal and Non-Ideal solutions. Geothermobarometry**.**	9 Lectures
V	ACF, AKF, AFM diagrams, Metamorphism vs Metasomatism - Metamorphic differentiation. **Petrography, nomenclature, classification and petrogenesis of the following rocks**: Slates – Phyllites – Schists – Gneisses – Granulites - Charnockites – Eclogites – Amphibolites – Khondalites – Migmatites. **Remote Sensing based mapping**-Igneous, Sedimentary and Metamorphic rocks.	9 Lectures
References	**Text Books:** 1. Tyrrell G.W, (2012). The Principles of Petrology, an Introduction to the Science of Rock. Sixth Edition, Surjeet publications. 2. Turner F.J., Verhoogen, J, (2004). Igneous and Metamorphic Petrology – CBS publishers. 3. Walter Ta Huang, (2012). Petrology, First Indian Print, Surjeet Publications. **Reference Books:** 1. Best, M. G, (2003). Igneous and Metamorphic Petrology. Wiley. New Delhi. 2. Best, M. G, (2005). Igneous Petrology. Wiley, New Delhi. 3. Bowen, N.L, (1928). Evolution of Igneous Rocks. 4. Donald W. Hyndman, (1985). Petrology of Igneous and Metamorphic Rocks, McGraw Hill Book co. 5. Hota, R.N, (2011). Practical Approach to Petrology. CBS, New Delhi. 6. Philipotts, (1992). An Igneous and Metamorphic Petrology, Prentice Hall. 7. Ernest G. Ehlers., Harvey Blatt, (1999). Igneous, Sedimentary and Metamorphic Rocks, CBS Publishers and Distributors, New Delhi. 8. Winter, J. D, (2010). Principles of Igneous and Metamorphic Petrology. PHI. New Delhi. ***Web resources:*** 1. *Underlined Titles are available in Swayam portal* 2. *http://en.wikipedia.org/wiki/Igneous_petrology* 3. *http://www.tulane.edu/~sanelson/eens212/intro&textures.htm* 4. *http://ericfdiaz.wordpress.com/an-introduction-to-igneous-petrology* 5. *Krishikosh.egranth.ac.in/bitstream/1/2023720/1/BPT9862pdf* 6. *http://www.pdfdrive.net/petrology-books html*	
Course Outcomes	On completion of Course, the students should be able to 1. Designate about the Magmatic process and formation of igneous rocks. 2. Identify the different types of Igneous Rocks 3. Explain about 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.	

18GEOP0208

IGNEOUS AND METAMORPHIC PETROLOGY

CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	2	1	2	2	1	2	3	2	3	2	1
CO2	3	3	1	2	2	1	1	3	2	2	2	1
CO3	3	2	1	2	3	1	2	3	2	3	2	2
CO4	3	3	1	3	3	1	2	3	1	1	1	3
CO5	3	3	1	3	3	1	2	3	2	3	3	2

Course Code & Title	18GEOP0209 **ECONOMIC GEOLOGY, MINERAL ECONOMICS AND MINING GEOLOGY**		
Class	M.Sc Geology and Geomatics	**Semester**	2nd Semester
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	The Course aims • To Understand the process of formation of ore deposits and classification of various mineral deposits • To Study about the metallic minerals and their properties, origin and distribution • To Study about the non-metallic minerals, their properties, origin and evolution • To Learn about the various mining methods and prospecting methods • To Acquire knowledge on the environmental impacts of mining.		

Unit	Content	No. of Hours
I	***Process of formation of Ore Deposits*** **:**Various process - Magmatic Concentration - Sublimation - Contact Metasomatism - Hydrothermal Process - Sedimentation - Bacterial process - Submarine exhalative and volcanic process - Evaporation - Residual and Mechanical concentration - Oxidation and Supergene Enrichment - Metamorphism - ***Classification of mineral deposits*** - **Controls and Localization of Mineral Deposits** - Metallogenic Epochs and Provinces - Geological Thermometry and barometry for Ore minerals.	9 Lectures
II	**Study of *Important Metallic Minerals***: Study of following Metallic Mineral Deposits and their Origin, Occurrence & Distribution in India and Uses - Platinum - Gold - Silver - Aluminum - Iron - Manganese - Chromium - Vanadium - Molybdenum - Tungsten - Nickel - Cobalt - Titanium - Copper - Lead - Zinc - Magnesium minerals.	9 Lectures
III	**Study of Important Non-Metallic Minerals:** Origin, Occurrence, Distribution in India and Uses of: Asbestos - Mica - Baryte - Talc - Ceramic Minerals - Building Stones - Cement Raw Materials - Mineral Pigments - Refractory Materials - Abrasive Minerals - Fertilizer Minerals and Gemstones. **Mineral Economics:** Significance of Minerals in National Economy - Demands and Supplies - Substitutes - Market Economy - Essential, Critical and Strategic Minerals - ***Mineral Conservation Policy***- India's Status in Mineral Production	9 Lectures

IV	**Mining Geology:** Introduction to Mining - Prospecting and Sampling - Trenching – Pitting – Exploratory Drilling and Calculation of Grades - Methods of Investigation of Ore Bodies. **Drilling Methods and Types of Drills** - **Classification of Mining methods**: Surface Mining - Alluvial Mining - Opencast mining or quarrying - Parts of Opencast mine: Bench Parameters - Mine Haulage. **Cycles of Mining Operation** - **Mine Explosives** - Ore Reserves Estimation - Application of Ore Microscope.	9 Lectures
V	**Underground Mining: Basic concepts and terms**: Shaft - adit - winze - raise - stope - mine support and ventilation **Open stope**: gophering mining method - Breast stope - Open underhand stoping - Open overhand stoping - Underground glory hole - Pillar and chamber method - Sub level stoping. **Supported stopes**: Overhand stoping method with supports - Timbered stopes - Square set method - Filled stopes - Shrinkage stopes - Mitchell slicing system- **Caving methods** - **Outline of underground coal mining methods** - Mining machineries - Organization and structure of a mine - **Role of a geologist in mining industry** - Mining legislations - Preparation of mine plans - mining scheme - ***Environmental Impact Assessment*** and Management Plans - Mine Accidents - Miner's Diseases.	9 Lectures
References	**Text Books:** 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. 4. Prasad, U., Economic Geology- Economic Mineral Deposits, Second Edition, CBS Publishers & Distributors Pvt Ltd., 2000. **Reference Books:** 1. Alistarir 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, Second Edition, Delhi, 1985. 6. Parbin Singh, Engineering and General Geology", S. K. Kataria& Sons, New Delhi, 2013. 7. Umathay, R.M., Mineral Deposits of India. Batisons, 2006. 8. Sinha, R.K.& Sharma, N.L., Treatise on industrial minerals of India, 1967. **Web resources:** 1. *Underlined Titles are available in Swayam portal* 2. *https://www.britannica.com/science/mineral-deposit/Formation-of-mineral-deposits* 3. *http://www.preservearticles.com/2012010519974/the-processes-of-formation-of-mineral-deposits-are-grouped-into-three-main-types.html* 4. *https://www.geologyforinvestors.com/classification-of-mineral-deposits/* 5. *https://iasmania.com/mineral-resources-india-iron-coal-aluminium-copper-lead-zinc/* 6. *http://www.aadnc-aandc.gc.ca/eng/1100100028056/1100100028058* 7. *https://everydayoil.wordpress.com/2012/11/16/different-types-of-drilling-and-its-breif-*	

	description/ 8. *http://www.cienciaviva.pt/img/upload/Introduction%20to%20mining.pdf.* 9. *https://www.americangeosciences.org/critical-issues/faq/what-are-main-mining-methods* 10. *http://emfi.mines.edu/emfi2011/Coal%20Mining%20Methods%20-%20EMFI%20Summary.pdf*
Course Outcomes	On completion of Course, the students should be able to 1. Describe the process of Ore formation. 2. Discuss 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. Analyze the Mineral economic strategies.

18GEOP0209

ECONOMIC GEOLOGY, MINERAL ECONOMICS AND MINING GEOLOGY

CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	2	1	2	3	1	2	3	2	3	2	2
CO2	3	1	1	1	3	1	1	3	1	3	2	1
CO3	3	3	1	3	3	2	2	3	3	3	2	2
CO4	3	3	1	3	3	2	2	3	2	2	2	2
CO5	3	1	1	1	1	1	1	3	1	1	1	1

Course Code & Title	18GEOP0210 **ENVIRONMENTAL GEOLOGY AND NATURAL DISASTER MANAGEMENT**		
Class	M.Sc Geology and Geomatics	**Semester**	2nd Semester
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To Know about the Importance of Environmental geology and various types of resources. • To Learn about the concept of Ecosystems, types of pollution, its causes and effects • To Understand the concepts of disasters, its classification, causes and impacts. • To Acquire knowledge about the various types of disasters.		

Unit	Content	No. of Hours
I	**Environmental Geology:** Planet Earth, environment and its types, scope and importance of Environmental Geology, public awareness, **Natural Resources;** types of resources (based on origin, based on continual utility). **Natural Resources and Associated Problems**: Forest resources, Water resources, Flood, Drought, Mineral resources,	9 Lectures
II	**Energy Resources, Land resources, Ecosystem:** concept of an ecosystem, structure and function of an ecosystem, producers, consumers and decomposers, energy flow in the ecosystem, Ecological succession, food chains, food webs and Ecological pyramids. **Causes, Effects and Control Measures of:** Air Pollution, Soil Pollution, Marine Pollution, Noise Pollution, Thermal Pollution, Nuclear Hazards	9 Lectures
III	***Introduction to Disaster*:** Concepts and Definitions. Disaster, Hazard, Risk, Vulnerability, Resilience. **Disaster: Classification, Causes and Impacts:** Natural Disaster: Beneath the Earth Surface: ***Earthquake*, Tsunami, *Volcanic Eruptions***.	9 Lectures
IV	***Natural Disaster*:** On the Surface: Landslides, Avalanche. **Meteorological / Hydrological Disasters;** Flood, Droughts, Windstorms, Hailstorms, Tornadoes, **Health; Epidemics.**	9 Lectures

V	**Approaches to Disaster Risk Reduction:** Disaster Management Cycle, Phases of Disaster Cycle. Culture of Safety, Prevention, mitigation and Preparedness. Structural measures, Components of Disaster Relief. Four phases of Disaster Management.	9 Lectures
References	**Text Books:** 1. Jonathan Turk and Graham R. Thompson, Environmental Geoscience: Saunders College Division, 2000. 2. Savindra Singh., Environmental Geography, Prayag Pustak Bhawan, Allahabad, 2012 **Reference Books:** 1. Chouhan, T.S.& Joshi, K.N., Applied Remote Sensing and Photo Interpretation, VigyanPrakashan, 1996. 2. Edward A. Keller, Environmental Geology (8th Edition) Prentice Hall, 1999. 3. Misra., S. P & Pandey, S.N., Essential Environmental studies, 3rd Edition, Ane Books Pvt. Ltd, 2011. **Web resources:** 1. *Underlined Titles are available in Swayam portal* 2. *http://www.svu.edu.eg/links/ictp/e_learning/links/courses/dr_abbas/course3/1.pdf* 3. *https://en.wikipedia.org/wiki/GIS_in_environmental_contamination* 4. *http://www.geo.unibe.ch/unibe/portal/fak_naturwis/e_geowiss/a_igeo/content/e42577/e42580/e454184/e454188/RWIforbeginnersA5-ERZ2_ger.pdf* 5. *http://www-naweb.iaea.org/napc/ih/documents/global_cycle/vol%20IV/IV_Ch4.pdf* 6. *https://www.conserve-energy-future.com/causes-and-effects-of-environmental-degradation.php* 7. *http://www.civileblog.com/types-of-soil/* 8. *http://environment.uwe.ac.uk/geocal/SoilMech/classification/default.htm* 9. *http://cbse.nic.in/natural%20hazards%20&%20disaster%20management.pdf* 10. *http://www.fao.org/3/a-i0304e.pdf* 11. *https://think-asia.org/bitstream/handle/11540/5035/disaster-management-handbook.pdf?sequence=1* 12. *http://www.untagsmd.ac.id/files/Perpustakaan_Digital_1/DISASTER%20MANAGEMENT%20Disaster%20Management%20Handbook.pdf*	
Course Outcomes	On completion of Course, the students should be able to 1. Assess the basics of Environmental Geology and Natural Disaster Management 2. Explain the concept of Natural Disaster Management 3. Analyze the risk and mitigation of hazards. 4. Identify the remote sensing technology and GIS for natural disaster management. 5. Discuss the Natural Disaster Management through Geospatial technology.	

18GEOP0210

ENVIRONMENTAL GEOLOGY AND NATURAL DISASTER MANAGEMENT

CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	2	3	2	2	1	2	3	2	2	2	2
CO2	3	3	2	3	2	2	2	3	2	3	2	2
CO3	3	2	2	2	2	2	2	3	2	3	2	2
CO4	3	3	1	3	3	2	2	3	3	3	2	2
CO5	3	3	1	1	2	2	2	3	3	2	2	1

Course Code & Title	18GEOP0211 **DIGITAL IMAGE PROCESSING AND GEOCOMPUTING**		
Class	M.Sc Geology and Geomatics	**Semester**	2nd Semester
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • *To Understand the principles of Image Processing* • *To Learn the various image processing techniques* • *To Gain knowledge on the Image classification* • *To Know about the various image processing software's.* • *To Describe about the computer applications in the field of geology*		

Unit	Content	No. of Hours
I	**Principles of Image Processing**: Digital Image formats - **Image Processing systems:** Hardware Component, Software Consideration and color composites, Image Display. **Image Restoration**: **Geometric Correction Methods**: Sources of Errors, Correction Processes. **Radiometric Correction**: Sources of errors, correction processes. **Atmospheric Correction Methods.**	12 Lectures
II	**Image Registration; Image Enhancement: Contrast Enhancement**; Linear Contrast stretch, Non-Linear Contrast enhancement. Histogram Equalization, Gaussian Stretch, Density Slicing. **Spatial Filtering;** Spatial convolution filtering, Low frequency filtering in the spatial domain, High frequency filtering in the spatial domain. **Edge enhancement in the Spatial Domain;** Linear edge enhancement, Band rationing, Color Ratio Composite Images	12 Lectures
III	**Image Classification: Supervised classification**; **The Classification Stage;** Minimum distance to Means Classifiers, Parallelepiped Classifiers, Gaussian Maximum Likelihood Classifier, **The Training Stage. Unsupervised classification**; Cluster building, Cluster Labeling, Reclassification Processing and Feature Extraction. Sub pixel classification, **Classification Accuracy Assessment;** Overall Classification Map Accuracy Assessment, Site Specific Classification Map Accuracy assessment. Classification Error Matrix	12 Lectures
IV	**Image Processing Software Introduction;** Introduction to Envi Image Processing Software, Introduction ERDAS Image Processing Software. **Image Analysis**; Band Ratioing, Principal Component Analysis, Normalized Density Vegetation Index, Normalized Density Water Index, Pan sharpening. Drone	12 Lectures

	data analysis. **Digital Online Data Sources;** Bhuvan, USGS, GLCF, and Google Earth. **Digital Elevation Model;** DEM from Line Features, Contours from DEM, Slope and Aspect, Line of Sight,	
V	**Computer Applications in Geology;** Aquachem, Rockworks, Petro plot, Stereonet, Igpet, IPI2WIN, Surfer, Petrograph, Tri plot, SPSS, Statistical, Origin. **Mobile Android Geological Softwares;** Field Move Clino, Smart Geology -Mineral Guide, Petrologic, Geological time scale, Strike and dip, Rocklogger, ArcGIS, Geo Area.	12 Lectures
References	**Text Books:** 1. Curran, P. (1985) Principles of Remote Sensing, Longman, London. 2. Nilblack, W. (1986) An Introduction to Digital Image Processing, III Edition, Prentice Hall International. 3. Bruce E. Davis, (2001) GIS A visual approach, Second edition, Onword Press/ Thomson Learning **Reference Books:** 1. Hord M.P, (1982) Digital Image Processing or Remotely Sensed Data, Academic Press. 2. Jenson, (2004) Introduction to digital image processing, Prentice Hall: 3 Edition. 3. Lillesand, T.M. and Kiefer, P.W, (2003) Remote Sensing and Image Interpretation, John Wiley & Sons, New York. 4. Paul J. Gibson and Clara H. Power (2000) Introductory Remote Sensing, Digital Image Processing and Applications, Routledge. 5. Pratt, S.K. (1990) Digital Image Processing, Wiley - Inter Science, New York. **Web resources:** 1. *Underlined Titles are available in Swayam portal* 2. *http://148.206.53.84/tesiuami/S_pdfs/Remote%20Sensing%20Digital%20Image%20Analysis.pdf* 3. *http://www.wamis.org/agm/pubs/agm8/Paper-5.pdf* 4. *http://www.fao.org/3/a-i0304e.pdf* 5. *https://think-asia.org/bitstream/handle/11540/5035/disaster-management-handbook.pdf?sequence=1* 6. *http://www.untagsmd.ac.id/files/Perpustakaan_Digital_1/DISASTER%20MANAGEMENT%20Disaster%20Management%20Handbook.pdf*	
Course Outcomes	On completion of Course, the students should be able to 1. Describe the principles of DIP 2. Identify the Image Enhancement techniques and its applications 3. Demonstrate Image Classification techniques 4. Categorize Geological software and its applications **5.** Describe the multimedia applications in Geology	

18GEOP0211

DIGITAL IMAGE PROCESSING AND GEOCOMPUTING

CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	3	1	2	3	2	1	3	2	2	2	1
CO2	3	3	1	2	2	1	1	3	2	2	3	2
CO3	3	3	1	3	3	2	1	3	2	2	2	2
CO4	3	3	1	2	3	2	2	3	3	3	3	2
CO5	3	2	3	1	2	2	1	3	1	2	2	2

Course Code & Title	18GEOP0212 **Igneous and Metamorphic Petrology & Economic Geology - PRACTICAL - III**		
Class	M. Sc Geology and Geomatics	**Semester**	2nd Semester
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	The Course aims • To Differentiate the megascopic properties of igneous, sedimentary and metamorphic rocks • to Discriminate the petrographic properties of rocks microscopically • To Study the optical properties of ore minerals • 'To Identify the economic minerals in hand specimen • To Learn the ore reserve Estimation		

Unit	Contents
	1. Megascopic Identification of Igneous, Sedimentary and Metamorphic rocks. 2. Microscopic Identification of Rock Fabrics, Mineral assemblages of Igneous, Sedimentary and Metamorphic rocks. 3. Calculation of C.I.P.W. Norm. 4. 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. 10. Identification of following important economic minerals in hand specimen A. Native Elements B. Oxides C. Oxide- Hydroxide D. Hydroxide E. Sulphides F. Sulphates G. Carbonates H. Chlorite halogen I. Silicates

	J. Phosphates K. Halites L. Oxide - spinel group **Ore Reserve Estimation** 1. Theory of sampling 2. Included area and valance weight method 3. Triangular grouping method 4. Area of Influencing method
Course Outcomes	On completion of Course, the students should be able to 1. Identify the Igneous, Sedimentary and Metamorphic rock 2. Evaluate the microscopic properties of Igneous, Sedimentary and Metamorphic rock 3. Prepare the Harker, Niggli and Ternary variation diagrams. 4. Prepare the ACF, AKF and AFM diagrams. 5. Identify the physical properties of important economic minerals.

18GEOP0212

Igneous and Metamorphic Petrology & Economic Geology - PRACTICAL - III

CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	1	1	2	3	2	2	3	2	2	2	1
CO2	3	3	1	2	3	2	1	3	2	2	2	1
CO3	3	3	1	3	3	1	2	3	3	3	2	2
CO4	3	3	1	3	3	1	2	3	3	3	2	2
CO5	3	2	1	2	2	1	1	3	2	2	1	1

Course Code & Title	18GEOP0213 **Digital Image Processing - PRACTICAL - IV**		
Class	M. Sc Geology and Geomatics	**Semester**	2nd Semester
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To Do geometric correction s of raw images • To Compute various image processing techniques • To Apply the classification techniques • To Generate DEM, contours, slope maps • To Understand the basic principles of geological softwares		

Unit	Contents
	Exploring the Digital Image Processing Software Interface and Working with True and False Color Composite using remotely sensed data sets. 1. Data download from Bhuvan, USGS, GLCF, and Google Earth. 2. Portal, and Blend, Flicker, Swipe and Geolinking. 3. Overlay of Vector Layer over Image. 4. Reading Raw Image, Reproject Raster and Geometric Correction. Mosaicing of Images 5. Spatial and Spectral Subset. 6. Image Enhancement/ Stretch, Apply Spatial Filter, Mosaic. 7. Pan sharpening. 8. Density Slicing 9. NDVI and NDWI Calculation. 10. Principal Component Analysis (PCA). 11. Band Rationing 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. Lidar data analysis 22. Drone data analysis 23. Generation of DEM from Line Features 24. Generation of Contours from DEM 25. Generation of Slope and Aspect 26. Generation of Line of Sight 27. Atmospheric Correction 28. Exploring the basic principles of geological softwares. a. Rockworks b. Igepet c. Surfer d. Aquachem e. Petroplot 29. Mobile Applications a) Field Move Clino b) Smart Geology -Mineral Guide c) Petrologic d) Geological time scale e) Strike and dip f) Rocklogger g) ArcGIS h) Geo Area
Course Outcomes	On completion of Course, the students should be able to 1. Geometrically correct the data 2. To Carry out the image processing techniques 3. To generate DEM, Line of Sight map, contour maps 4. Work with various geological softwares. 5. To apply mobile technology in geological mapping

18GEOP0213

Digital Image Processing - PRACTICAL - IV

CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	1	1	1	2	1	1	3	1	1	2	1
CO2	3	3	1	3	3	2	1	3	3	3	2	1
CO3	3	3	1	3	3	3	1	3	3	2	2	2
CO4	3	3	1	3	2	1	1	3	2	2	1	1
CO5	3	3	1	3	2	1	1	3	2	2	1	1

Course Code & Title	18GEOP0314 **SEDIMENTARY PETROLOGY AND MARINE GEOLOGY**		
Class	M.Sc Geology and Geomatics	**Semester**	3rd Semester
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To Learn about the Physical properties, classification and composition of sedimentary rocks • To Study the petro graphical properties of clastic and non-clastic sedimentary rocks • To Understand the environment of deposition through grain size analysis and XRF methods • To Learn about the scope and importance of marine geology, classification of coast and the important marine mineral deposits. • To Acquire knowledge about the microfossils, properties of sea, and various marine samplers.		

Unit	Content	No. of Hours
I	***Sedimentary Petrology*:** Physical properties of sedimentary particles and minerals - Mineral Stability and their Significance - Porosity and Permeability. **Classification and Composition of Sedimentary rocks**- Textures, ***Structures*** and their Environmental Significance. Provenance of sediments - ***Lithification and diagenesis***. **Sedimentation and tectonics**: tectonic control of sedimentation, geosynclines and their lithological association, plate tectonics in relation type and evolution of basins	9 Lectures
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.	9 Lectures
III	**Environment of Deposition:** Non-marine, Transitional and Marine Environments and products. **Outline on Grain size analysis**: Heavy mineral analysis, Clay mineral analysis and palaeo environmental studies. **Grain size determination:** sample preparation, direct measurements, dry and wet sieving. Grain size analysis and graphical representation. Provenance of sedimentary rocks. **Analysis of sedimentary rocks:** XRF and SEM methods. Sedimentary basins and sedimentary depositional environments. Role of colloids in sedimentation.	9 Lectures

IV	**Marine Geology:** ***Introduction and scope of marine geology,*** Oceanic profile, oceanic features, beaches. **Classification of coast:** erosion and accretion. Waves, Currents and Tides. Coastal protection structures. **Classification of marine mineral deposits:** Origin and depositional system of marine resources. **Beach placers**: Shelf deposits, Deep Ocean phosphatic, Polymetallic nodules, Sulphate deposits, Hydrocarbon deposits	9 Lectures
V	**Sea water as a resource**: ***Ocean circulation, turbidity current***, submarine and sedimentational processes. **Oceanic sediments and microfossils**: Marine stratigraphy, correlation and chronology. **Tectonic history of the oceans-** Concept of sea level changes. Seismic stratigraphy and sequence stratigraphy as applied to marine geology. Physical and chemical properties of sea water. Marine pollution, path ways, resilence time, pollutants in the marine environment. **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.	9 Lectures
References	**Text Books:** 1. Maurice E. Tucker, (2001). Sedimentary Petrology an Introduction to the origin of Sedimentary Rocks. Third edition. 2. Sengupta S.M, (2011). Introduction to Sedimentology, CBS Publishers and Distributors, Second edition. 3. Tyrrell, G.W, (2012). The Principles of Petrology, an Introduction to the Science of Rock. Sixth Edition, Surjeet publications. 4. Gary Nichols, (2009). Sedimentology and Stratigraphy, Second Edition. 5. Lal D.S, (2013). Climatology and Oceanography, Sharda Pustak Bhavan Publishers and Distributors. 6. Savindra Singh, (2014). Oceanography, Pravalika Publications.U.S Army Corps of Engineers, (1995). Coastal Geology, University Press of the Pacific Honolulu, Hawaii **Reference Books:** *1.* *Underlined Titles are available in Swayam portal* *2.* Collision, J.D., Thompson, D.B, (1989). Sedimentary Structures. 2nd Ed. Unwin Hyman, London. *3.* Maurice E. Tucker, (2001). Sedimentary Petrology an Introduction to the origin of Sedimentary Rocks. Third edition. 4. Pettijohn, F.J., (1975). Sedimentary Rocks, Harper & Row, New York, 3rd Edision. 5. Reineck, H.E., Singh I.B. (1980). Depositional Sedimentary Environments, Springer Verlag. 6. Ernest, G. Ehlers., Harvey Blatt, (1999). Igneous, Sedimentary and Metamorphic Rocks, CBS Publishers and Distributors, New Delhi. **Web Resources:** **1.** www.usouthal.edu/geology/haywick/GY402/402-pp1.pdf. **2.** https://www.lib.utexas.edu/geo/folkready/entirefolkpdf.pdf	

Course Outcomes	On completion of Course, the students should 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. Analyze the marine environments using marine geological instruments. 5. Identify the suitable remote sensing applications in ocean sciences

18GEOP0314

SEDIMENTARY PETROLOGY AND MARINE GEOLOGY

CO/PO	**PO**							**PSO**			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**
CO1	3	1	1	2	1	1	1	3	2	2	1
CO2	3	2	1	2	2	1	1	3	2	2	1
CO3	3	1	1	2	2	1	1	3	2	2	1
CO4	3	2	1	2	3	2	1	3	2	2	2
CO5	3	2	1	2	2	1	1	3	2	2	1

Course Code & Title	18GEOP0315 **HYDROGEOLOGY AND ENGINEERING GEOLOGY**		
Class	M.Sc Geology and Geomatics	**Semester**	3rd Semester
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To Describe about the hydrological properties of rocks • To Illustrate the physical parameters of water quality standards • To Understand the concept of groundwater basins • To Know about the engineering properties of rocks • To Learn about the geological considerations for constructing dams, reservoirs, tunnels		

Unit	Content	No. of Hours
I	**Hydrological Properties of Rocks:** Porosity, Permeability, Specific Yield and Specific Retention, Base Flow, Transmissivity and Storage Coefficient - **Ground Water Flow Equations**: Steady and Transient Flow. **Darcy's Law:** Hydraulic Conductivity, Steady, Unsteady and Radial Flow - Aquifers: Types and Hydro stratigraphic Units - **Pumping Tests**: Definition, Methodology, Data Collection, and Interpretation by Theis, Cooper-Jacob's methods. Drilling Methods for Groundwater Bore Wells.	12 Lectures
II	**Physical Parameters of Groundwater Quality** - Analysis of Major and Minor Elements in groundwater using APHA standards - **Outline of Water Quality Standards and Guidelines**: WHO, BIS and ICAR - Water Quality Parameters for Drinking, Agriculture, and Industrial Uses - **Graphical Representation and Interpretation of Water Quality Data:** WILCOX, USSL, GIBBS plot, Piper, Donean and Durov diagrams - Coastal Aquifers: Ghyben-Herzberg relation and Saline Water Intrusion.	12 Lectures
III	**Groundwater Basins**: Drainage and Basin Morphometry - Methods of determining groundwater flow and preparation of water table contour maps - Problems due to over exploitation of groundwater. **Groundwater recharge:** natural and artificial methods. **Rainwater harvesting**: definition, methods, and design of harvesting structures - ***Outline of methods of groundwater***	12 Lectures

	exploration - Groundwater provinces of India and Tamil Nadu.	
IV	**Engineering properties of rocks**: Rocks as materials for construction – Rocks as sites for construction - Specific Gravity, Porosity, Absorption, Strength of rocks, compressive strength, tensile strength. Poissen's ratio and their measurement - Soil profile, soil particles, soil structure, plasticity & swelling - Decorative stones & Building Stones.	12 Lectures
V	**Dams and Reservoirs:** Classification & types Problems & failures of dams - A brief account on Major Indian Dams - **Tunnels:** Classification & nomenclature, Geological survey prior to tunneling - **Landslides**: Types & causes, Preventive measures, Road network & related problems & preventive measures, Ghats road alignment.	12 Lectures
References	**Text Books:** 1. David Keith Todd, Larry W. Mays, (2013) Groundwater Hydrology, wiley. 2. Fetter, C. W, (2007) Applied Hydrology, CBS Publications. 3. Herman Bouwer, (2014) Groundwater Hydrology, McGraw hill education private limited. 4. Raghunath, H.M., (2003) Groundwater, New age international publications. **Reference Books:** 1. Bankar K.M., Principles of Engineering Geology, Edition: 2014, Published by Nem Chand Jain for Standard Publishers Distributors 2. Deman, MCJ. Smith G.S and Verstappen, H. T. (1986), Remote Sensing for resources development and environmental management, A. A. Ballkema Publishers, Totterdam, Netherlands. 1986. 3. Paine, D.P, (1981) Aerial photography and image interpretation for resource management, Wiley and Sons, New York. 4. Ramakrishnan. S. (1998) Groundwater, CBS Publishers & Distributors. 5. Parbin Singh, Engineering and General Geology, Eight Revised Edition, Published by S.K. Kataria & Sons.	
Course Outcomes	On completion of Course, the students should be able to 1. Predict the origin and occurrence of ground water 2. Describe the properties of groundwater 3. Analyze the Groundwater Basins and rain water harvesting methods 4. Assess the properties of Rocks for engineering purposes. 5. Discuss the various types of Dams and Landslides	

18GEOP0315

HYDROGEOLOGY AND ENGINEERING GEOLOGY

CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	2	1	3	3	2	1	3	2	2	2	2
CO2	3	2	1	2	3	1	1	3	2	3	2	2
CO3	3	3	1	3	3	2	1	3	2	3	2	2
CO4	3	3	1	2	3	1	1	3	2	2	2	2
CO5	3	3	2	3	3	2	1	3	2	2	2	2

Course Code & Title	18GEOP0316 **GEOPHYSICS AND GEOCHEMISTRY**		
Class	M.Sc Geology and Geomatics	**Semester**	3rd Semester
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	The Course aims • To Know about the geophysical properties of earth • To Learn about the magnetic methods of exploration • To Describe about the Electric method of exploration, its interpretation and analysis techniques. • To Gain knowledge about the seismic method of exploration • To Illustrate about the principles of Exploration geochemistry		

Unit	Content	No. of Hours
I	***Properties of the Earth***: Gravitational - Electrical - Magnetic - Thermal and Chemical - **Gravity Methods**: Introduction - Gravitational field of the Earth - Densities of rocks and minerals - **Instruments**: Pendulum - Torsion Balance - Gravity meters. Field procedures - **Reduction of gravity data**: Latitude correction - Free air correction - Bouguer correction - Terrain correction and Tidal correction. Gravity anomaly maps and Interpretation of gravity data. ***Radioactive Methods***: Introduction - Radioactive decay - Radioactivity of rocks and minerals - Instruments: Geiger- muller counters - Scintillation counters - Gamma ray spectrometers. Field procedures - Interpretation of radiometric data - Applications and Limitations.	9 Lectures
II	**Magnetic Methods**: Introduction - Earth's Magnetism - Magnetism of rocks and minerals: Induced and remnant magnetism. Instruments: Schmidt type Magnetometers: Vertical force magnetometer - Horizontal force magnetometer - Torsion magnetometer - Field procedures - Reduction of data: Temperature correction - Correction for diurnal variations - Normal corrections - Preparation of magnetic anomaly maps and profiles - Interpretations - Applications and limitations. - **Electromagnetic Methods:** General principles- Instruments- Field procedures - Anomalies - Applications and limitations - **Brief outline of Telluric and Magneto Telluric Fields**.	9 Lectures

III	**Electrical Methods:** Introduction **- Resistivity methods:** Principles - Instruments: D.C Potentiometer - Electric mill voltmeter. Electrode arrangements: Wenner arrangement - Schlumberger arrangement – Single Pole arrangement and Dipole system of electrode arrangement - **Field procedures**: Lateral exploration or profiling- Vertical Exploration or Depth sounding **- Interpretation - Application of resistivity methods. Self-Potential method: Principle - Instruments -:** Non-polarizable electrodes - The potentiometer - Electric milli voltmeter. **Field procedure** - Interpretation - Applications. **Induced Polarization Methods:** Principle - Electrode polarization - Instruments Field procedures - Interpretation - Applications.	9 Lectures
IV	**Seismic Methods:** Principle -Seismology and seismic prospecting - Elastic properties of rocks - Refraction and Reflection of seismic waves - Instruments: Geophones - Amplifiers and filters - Gain control systems - Time markings Magnetic recorders - Operational methods: Fan shooting, Arc shooting and Profile shooting - Reduction of data - Interpretation - Applications and limitations - **Ore Guides**: Regional and local parameters for exploration - Regional and detailed exploration - Drilling methods - selection sites - angle and direction of bore holes - logging - bore hole deviation.	9 Lectures
V	***Exploration Geochemistry*:** Outline and Classification of Elements - Geochemical Anomaly and Province - Geochemical cycle - Primary and Secondary Dispersion of elements - Controls of dispersion - Mobility of elements - Application of Utility of path finder elements and minerals. **Geochemical Surveys**: Definition – Types - Sampling Methodology – Application to mineral deposits - Outline of analytical methods used in Exploration Geochemistry - ***Short account on Geo-botanical prospecting***.	9 Lectures
References	**Text Books:** 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 Books:** 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.	

	Web resources: 1. *Underlined Titles are available in Swayam portal* 2. *https://www.school-for-champions.com/astronomy/earth.htm#.WxddcO6FO70* 3. *https://geoinfo.nmt.edu/geoscience/projects/astronauts/gravity_method.html* 4. *http://www.geol-amu.org/notes/b8-4-4.htm* 5. *https://www.michigan.gov/documents/deq/GIMDL-USGSINF672R6_302983_7.pdf* 6. *http://www.geol-amu.org/notes/b8-3-6.html* 7. *https://csegrecorder.com/articles/view/magnetic-and-gravity-methods-in-mineral-exploration* 8. *http://rallen.berkeley.edu/teaching/F04_GEO594_IntroAppGeophys/Lectures/L05.pdf* 9. *http://crack.seismo.unr.edu/ftp/pub/louie/class/492/data/2011/gph492_all_files_2011/AppliedGeophysics_Telf ord/AppliedGPH_MagneticMethods.pdf* 10. *https://sites.ualberta.ca/~unsworth/UA-classes/223/notes223/223D1-2009.pdf* 11. *http://www.engr.uconn.edu/~lanbo/G228378Lect0510EM1.pdf* 12. *https://www.kau.edu.sa/Files/0003035/Subjects/EM(1).pdf* 13. *http://shodhganga.inflibnet.ac.in/bitstream/10603/65005/8/08_chapter%201.pdf* 14. *http://www.tomoquest.com/attachments/File/EEG_Electrical_Surveying_SP.pdf* 15. *http://en.geophysik.at/index.php/methods/seismic-methods* 16. *http://www.geosearches.com/seismic.php* 17. *http://www.subsurfacesurveys.com/pdf/Methods.pdf* 18. *http://www.mdru.ubc.ca/home/resources/seg/seg_talks/Ray_Lett_Notes.pdf* 19. *http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.489.6536&rep=rep1&type=pdf*
Course Outcomes	On completion of Course, the students should be able to 1. Explain the basic principles, Field procedure and application of Gravity methods and radioactive methods for Geological studies. 2. Analyze 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

18GEOP0316
GEOPHYSICS AND GEOCHEMISTRY

CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	2	1	2	3	1	1	3	2	2	2	1
CO2	3	2	1	2	3	1	1	3	2	2	2	1
CO3	3	2	1	2	3	1	1	3	2	2	2	1
CO4	3	2	1	2	3	1	1	3	2	2	2	1
CO5	3	2	1	2	3	1	1	3	2	2	2	1

Course Code & Title	18GEOP03E1 **EXPERIMENTAL PETROLOGY (MAJOR ELECTIVE)**		
Class	M.Sc Geology and Geomatics	**Semester**	3rd Semester
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • *To Understand the principles of Experimental petrology* • *To Learn about the process involved in thermodynamics.* • *To Evaluate thermodynamic data using Raoult's Law and Henny's law* • *To Calibrate the geothermometers and Geobarometers from the experimental thermodynamic data* • *To Know about the oxidation reactions*		

Unit	Content	No. of Hours
I	**Experimental Petrology:** High Temperature – Pressure Techniques, Hydrothermal apparatus and Piston Cylinder, Experiments on Solid – Solid Dehydration and Decarbonation Reaction.	12 Lectures
II	**Thermodynamics:** Gibb's Energy and equilibrium constant, mole fraction, activity coefficients. Regular and sub regular solutions. Standard states, fugacity and activity	12 Lectures
III	**Raoult's Law, Henny's Law**, Heat Capacity, Evaluation and tabulation of thermodynamic data. Isobaric thermal expansion and pressures.	12 Lectures
IV	**Calibrations of Geothermometers and geobarometers** from thermodynamic and experimental data. Reduced activity of water from dehydration reactions	12 Lectures
V	Log O_2 from oxidation reactions.	13 Lectures
References	**Text Books:** 1. Chatterjee.N.D.(1991) Applied Mineralogical Thermodynamics. Springer Verlag 2. Koch, G.S and Link, R.F. (1970) Statistical Analysis of Geological Data. John Wiley. **Reference Books:** 1. Powell, R. (1978) Equilibrium Thermodynamics in Petrology, an Introduction, Harper & Row. 2. Wood, B.J. and Frasser, D.G (1976) Elementary Thermodynamics for Geologists. Oxford Univ. Press.	

Course Outcomes	On completion of Course, the students should be able to • Explain about the principles of Experimental petrology • Describe about the concepts of thermodynamics • Evaluate the Thermodynamic data using Raoult's Law and Henny's Law • Calibrate Geothermometers and Geobarometers • Elaborate Oxidation reaction

18GEOP03E1

Experimental Petrology (Major Elective)

CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	2	1	1	3	1	1	3	2	2	2	1
CO2	3	1	1	1	2	1	1	3	2	2	2	1
CO3	3	2	1	2	3	1	1	3	2	2	2	1
CO4	3	3	1	2	3	1	1	3	1	1	2	1
CO5	3	1	1	2	3	1	2	3	1	1	2	1

Course Code & Title	18GEOP03E2 **ADVANCED ORE PETROLOGY (MAJOR ELECTIVE)**		
Class	M.Sc Geology and Geomatics	**Semester**	3rd Semester
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	The Course aims • To Understand the modern concepts of ore genesis • To Study in detail about the ore isotopes • To Acquire knowledge about the ore deposits • To Learn about the plate tectonic and the related ore genesis • To Describe about the advanced studies in ore genesis		

Unit	Content	No. of Hours
I	**Modern Concepts of Ore Genesis**: Detailed study of all principal ore mineral groups - their textures and structures - Chemistry of ore minerals and host rocks - Paragenesis - paragenetic sequences and zoning in metallic ore deposits - Methods in geothermometry - geobarometry in ore-geology.	12 Lectures
II	**Stable and Radiogenic Isotopes of Ores and the Host Rocks**: Specialized models of ore deposits related to mafic and intermediate to felsic intrusions - Vein-deposits and ore deposits related to sub areal and submarine volcanism	12 Lectures
III	**Detailed Study of Ore Deposits:** Chemical precipitates - syngenetic clastic beds and by weathering - Significance of stratiform and strata - bound ore deposits of sedimentary affiliation and those of metamorphic affiliation	12 Lectures
IV	**Plate Tectonics and Ore Genesis**: Ore deposits of oceanic crust - ocean floor and those related to plate subduction - Geological modeling for mineral exploration	13 Lectures
V	**Advance Study of Ore:** Ore mineral textures and their application in paragenesis - Application of ore microscopy in mineral technology - Geochemical modeling of ore deposits	12 Lectures
	Text Books: 1. Wolf, K.H., (1981) Hand Book of Strata bound and Stratiform Ore Deposits. Elsevier. **Reference Books:** 1. Klemm, D.D. and Schneider, H.J., (1977) Time- and Strata Bound Ore Deposits. Springer Verlag. 2. Ramdohr, R, (1969) The Ore Minerals and Their Intergrowths. Pergamon Press.	

References	3. Arogyaswamy, R. N. P., (1980) Courses in Mining Geology. Oxford & IBH, New Delhi. 4. Bateman, A. (2013) Economic Mineral Deposits, John Wiley.
Course Outcomes	On completion of Course, the students should be able to 1. Explain the Modern Concepts of Ore Genesis 2. Discuss about Stable and Radiogenic Isotopes of Ores and the Host Rocks 3. Identify the Ore Deposits 4. Describe about the Plate Tectonics and Ore Genesis 5. Explain the Advance Study of Ore

18GEOP03E2

ADVANCED ORE PETROLOGY (MAJOR ELECTIVE)

CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	1	1	1	2	1	2	3	1	1	2	1
CO2	3	1	1	1	2	1	1	3	2	2	2	1
CO3	3	2	1	1	3	2	1	3	1	3	2	1
CO4	3	1	1	2	1	1	1	3	1	3	2	1
CO5	3	2	1	1	2	1	1	3	1	2	2	1

Course Code & Title	18GEOP03E3 **GEOGRAPHIC INFORMATION SYSTEM & GEOCOMPUTING (MAJOR ELECTIVE)**		
Class	M.Sc Geology and Geomatics	**Semester**	3rd Semester
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To Provide the basic principles of GIS • To Learn about the different types of data • To Know about the basic concepts of data • To Analyze and interpret the data • To Gain knowledge about the advanced processing techniques in GIS		

Unit	Content	No. of Hours
I	**GIS Overview:** Introduction to GIS and GIS Infrastructure. GIS hardware components and GIS roles. **Geographic data and database**- Data and information definitions Geographic data: spatial data, types of GIS database and discrete and continuous data GIS data characteristics Spatial Data Relationships, Proximity Relationships Time and GIS data.	12 Lectures
II	**Raster and vector data:** Raster and Vector data and Models - **Raster data:** Raster Coding, Resolution, Gridding and Linear features - Raster Precision and Accuracy - **Vector Data.** Raster and Vector Structures - Raster and Vector Advantages and Disadvantages - **Topology,** Appling Topology - Topology Tables - Multiple Connectivity - Topology and Relational Queries - Topology contribution.	13 Lectures
III	**Data entry**: Introduction - **Data quality:** Error, Accuracy, Precision - Generalization and derived data - Scale and Precision, scale differences, scale incompatibility - Area and coverage, Incomplete Coverage, Smallest Scale Rule - Data Problems, Continuous Data Interpretation, Complete and Consistent Data - **Acquiring and Distribution of data:** Data Accessibility, Data Cost, Data Standards, Meta Data - Distributed GIS: Advantages and Disadvantages - Online GIS - Open GIS.	12 Lectures
IV	**Inventory operations and basic Analyses**: Viewing GIS, Database reading - Database Queries and Summaries - Relational Database Queries, Boolean Queries and Graphical Selection Queries - Measurement and Types, Distance applications, Reports - **Theme Modification** : Subsets and Tiles - Spatial deletes, dissolve and merge - Recoding and reclassification - **Basic Analyses:**	12 Lectures

	Introduction - Overlay, Visual Overlay, Data Merging Overlay, Overlay Principles - Intersect and union, - Overlay options, clip options - Mask and Replace - Database Merging and Applying Theme - Buffers and applications, Spatial analyses - Statistical Reporting and Graphing.	
V	**Advanced analyses:** Proximity analyses, Nearest features, Spider diagrams, Distance selection, Aggregation - Spatial operations: Centroids, Thiessen polygons - Tracking GIS - **Terrain analyses:** Elevation analyses, Terrain profiles - 3D views, Slope and Aspect, Shaded Relief views and View analyses - Overlays and Additional features, Dropping, Perspective views and Z data views - GIS output: types, Maps, Legends and Supporting elements - **Future GIS**.	12 Lectures
References	**Text Books:** 1. Burrough, P.A(1986) Principles of Geographical Information Systems for Land Resources Assessment, Clarandone Press, Oxford. 2. Tor Bernhardsen, (2007) Geographic Information System – An introduction", third edition, 3. Bruce E. Davis, (2001), GIS Visual Approach, Second Edition **Reference Books:** 1. Kang - Tsung Chang, (2002) Introduction to Geographic Information System, MC Graw Hill, Boston. 2. Campbell, J, (1984) Introductory Cartography, Printers Hall Englewood Cliffs, N.J, 3. Dent B.D, (1985) Principles of Thematic Map Design, Addition - Wesley, Reading, Mass. 4. Freeman, H and Pieroni, GG. (1980) Map Data Processing, Academic Press, New York. 5. Gurugnanam, B., (2009) Geographic Information System, New India Publishing Agency. **Web Resources:** *1. https://www.saylor.org/site/textbooks/Essentials%20of%20Geographic%20Information%20Systems.pdf* *2. https://webapps.itc.utwente.nl/librarywww/papers_2009/general/PrinciplesGIS.pdf* *3. http://www.geografie.webzdarma.cz/GIS-skriptum.pdf*	
Course Outcomes	On completion of Course, the students should be able to 1. Discuss about the GIS Overview, Geographic data and database 2. Explain about the Raster and vector data, Topology 3. Discuss about the Data entry, Data quality, Acquiring and Distribution of data 4. Analyze the Inventory operations and basic Analyses, Theme Modification, Basic Analyses 5. Analyze the Advanced analyses, Terrain analyses, Future GIS	

18GEOP03E3

GEOGRAPHIC INFORMATION SYSTEM & GEOCOMPUTING (MAJOR ELECTIVE)

CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	2	1	1	3	1	1	3	1	1	2	1
CO2	3	2	1	2	3	1	1	3	2	2	2	1
CO3	3	3	1	2	3	1	1	3	2	2	2	1
CO4	3	2	1	2	3	1	1	3	2	2	1	1
CO5	3	3	1	2	3	1	1	3	2	2	2	1

Course Code & Title	18GGMPO317 GEOPHYSICAL, GEOCHEMISTRY, HYDROGEOLOGY AND SEDIMENTOLOGY - PRACTICAL V		
Class	M. Sc Geology and Geomatics	**Semester**	3rd Semester
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To Analyze and interpret the resistivity data using Wenner method and schlumberger method • To Interpret the structures using Gravity and seismic data • To Process, analyze and interpret the geochemical data • To Identify the Megascopic and microscopic properties of Sedimentary rocks • To Know about the grain size analysis techniques.		

Unit	Contents
	1. Resistivity survey and the interpretation for lithology and water resources - Wenner method 2. Resistivity survey and the interpretation for lithology and water resources - Schlumberger method 3. Geological and structural interpretation using Gravity data 4. Geological and structural interpretation using seismic data. 5. Find out the half life period of the elements by using Radiometric data. 6. Geochemical Sample preparation (A solution, B solution) 7. Geochemical anomaly map preparation and interpretation 8. Statistical analysis of geochemical data. 9. Mean aerial depth of rainfall Assessment. 10. Rainfall - Arithmetic mean method Assessment. 11. Rainfall - Thiesson polygon method Assessment. 12. Rainfall – Isohyetal method Assessment. 13. Problems - Porosity Specific and Specific yield retention. 14. Major elements Analysis for water. 15. Graphical interpretation of water quality data. 16. Water Quality - Irrigation use Assessment. 17. Pumping test data interpretation. 18. Isohyetal map generation through surfer software. ***SEDIMENTOLOGY*** *1. Megascopic and microscopic and description of the sedimentary rocks*

	2. *Microscopic examination of important sedimentary rocks Sieve Analysis/ Trask's method, Folk and Ward method* 3. *Techniques and procedures used in the study of sediment and sedimentary rocks. Collection, Analysis and Interpretation of data on size, sorting, roundness and sphericity*
Course Outcomes	On completion of Course, the students will be able to 1. Predict the subsurface lithologies through electrical methods 2. Use of Gravity and Seismic data for structural interpretation 3. Analyze the half-life period of the Elements by using radiometric data 4. Compile the Geochemical anomaly map. 5. Interpret Water quality analysis

18GGMPO317
GEOPHYSICAL, GEOCHEMISTRY, HYDROGEOLOGY AND SEDIMENTOLOGY - PRACTICAL V

CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	2	1	2	3	1	1	3	2	3	2	1
CO2	3	3	1	2	3	1	1	3	2	3	2	1
CO3	3	3	1	2	3	1	1	3	2	3	2	1
CO4	3	3	1	2	2	1	1	3	2	3	2	1
CO5	3	3	1	3	3	1	1	3	2	3	2	1

Course Code & Title	18GGMPO318 **GEOGRAPHIC INFORMATION SYSTEM AND GPS- PRACTICAL VI**		
Class	M. Sc Geology and Geomatics	**Semester**	3rd Semester
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To Learn to handle the fundamental tools of ArcGIS software • To Gain a detailed knowledge in map registration, GDB creation and Digitization • To Compute the various Conversion and overlay techniques • To Do the Mosaicking, DEM generation, Classification processes		

Unit	Contents
	1. Introduction to Arc GIS Features and Tools 2. Map Registration a. Toposheet Registration b. Registration using GCP's c. Viewer to viewer Registration 3. GDB Creation 4. Feature Data Creation a. Point generation and Add field b. Line feature generation and Add field c. Polygon feature generation and Add field 5. Digitization and working with Advanced Editing tools a. Cut polygon b. Shape editing c. Edit vertices 6. Geometric and field calculation 7. CSV to feature generation 8. Conversion Exercise a. Feature to line b. Feature to polygon c. kml to layer d. Layer to kml 9. Overlay analysis a. Union b. Split c. Merge d. Join 10. Theme Generation 11. Topology analysis 12. Map layout 13. Map Generalization 14. Importing Field Photo to ArcGIS 15. Query Analysis 16. LAS Dataset & LIDAR Dataset 17. Road Network Analysis

	18. Subtitle - Group of features 19. Spatial Join 20. Mosaic 21. Model Builder 22. NDVI and NDWI in GIS 23. DEM in GIS 24. Image Classification 25. Line of Site Analysis 26. Pan Sharpening 27. Watershed Generation from SRTM & Contour. 28. Create Table and Input Data suitable to GIS theme such as Administrative Boundary, Road and Infrastructure Layers. 29. Retrieve data from Table by Building Queries for Various Requirements. 30. Location capturing Using GPS, 31. Accuracy assessment in GPS
Course Outcomes	On completion of Course, the students will be able to 1. Able to handle ArcGIS tools 2. Compute process like Map registration, GDB creation, Digitization and overlay analysis 3. Carry out Mosaicking, DEM generation, NDVI, NDWI 4. Generate Contour maps and classified images through image classification 5. Assess the location accuracy using GPS

18GGMPO318

GEOGRAPHIC INFORMATION SYSTEM AND GPS- PRACTICAL VI

CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	3	1	1	3	1	1	3	1	1	2	1
CO2	3	3	1	2	3	1	1	3	2	2	2	1
CO3	3	3	1	2	3	1	1	3	2	2	2	1
CO4	2	2	1	3	3	1	1	3	2	2	2	1
CO5	3	3	1	1	3	1	1	3	1	1	2	1

Course Code & Title	18GGMPO3M1 **MEDICAL GEOLOGY (MODULAR COURSE)**		
Class	M. Sc Geology and Geomatics	**Semester**	3rd Semester
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	The Course aims • To Know about the basic principles of medical geology • To Learn in detail about the Geological impacts of trace elements in nutrition • To Gain knowledge about the medicinal value of various minerals by understanding the physical and chemical properties.		

Unit	Content	No. of Hours
I	**Introduction to Medical Geology:** Medical Geology: Natural Distribution and Abundance of Elements, Functions of major and minor elements in human body, the functional value of Trace elements, Geological Impacts on Nutrition**;** Physical, chemical properties, Origin and Distribution, Uses and medicinal value of **Magnesite, Gypsum**, **Calcite**, **Fossiliferous Limestone, Red Ocher, Asbestos, Sulphur, Cinnabar**	13 Lectures
II	Physical, chemical properties, Origin and Distribution, Uses and medicinal value of **Orpiment**, **Realgar, Ferrogenous Shale, Chalcanthite, Rock Salt, Borex, Malachite and Azurite, Salt Petre and Mica**, **Hematite, Magnetite and Siderite**	13 Lectures
References	**Text Books:** 1. Park, K. (2013) Text book of Preventive and social medicine, M/s Banaras bhanot publishers Jabalpur.2013. 2. Park.K (2015) Essential of Community Health Nursing, Seventh Edition, M/S Banarsidas Bhanot Pyblishers. 3. Sornamariammal (2016) Bogar Ezayiraththil Siddha Maruththuva Kanimangal. Published by World Siddha Trust. **Reference Books:** 1. David Werner (1993) Where there is no doctor, Reprinted, Macmillan. 2. Singh, R.Y. (2007) Geography of settlement, Reprinted, Rawat publications. 3. Purohit, N.J. (2014) Earth Science, Geology, Environmental and the Universe, 1st Edition, Swastik Publications, New Delhi, India 4. Skinner C.H and Berfer R.A. (2000) Geology and Health, Oxford University Press. 5. Selninus, E. D. (2000) Essentials of Medical Geology, Elsevier.	

	Web Resources: 1. *https://www.saylor.org/site/textbooks/Essentials%20of%20Geographic%20Information%20Systems.pdf* 2. *https://webapps.itc.utwente.nl/librarywww/papers_2009/general/PrinciplesGIS.pdf* 3. *http://www.geografie.webzdarma.cz/GIS-skriptum.pdf*
Course Outcomes	On completion of Course, the students should be able to 1. Explain about the Importance of Geology in Medicine and the characteristics and role of Magnesite, Gypsum, Calcite, Fossiliferous Limestone, Red Ocher, Asbestos, Sulphur, Cinnabar in Medicine. 2. Use the knowledge of and its application of this material in Medical Science Orpiment, Realgar, Ferrogenous Shale, Chalcanthite, Rock Salt, Borex, Azurite, Salt Petre and Mica, Hematite, Magnetite and Siderite.

18GGMPO3M1

MEDICAL GEOLOGY (MODULAR COURSE)

CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	1	1	1	2	2	2	3	2	3	2	2
CO2	3	1	1	1	2	2	2	3	2	3	2	2

Course Code & Title	18GGMPO3M2 **Micropaleontology (Modular Course)**		
Class	M. Sc Geology and Geomatics	**Semester**	3rd Semester
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • *To Learn the sampling methods as well as the processing techniques* • *To Interpret and rebuild the paleo environments using microfossils* • *To Understand the role of microfossils in hydrocarbon exploration*		

Unit	Content	No. of Hours
I	**Surface and subsurface sampling method Processing of samples** - Morphology - classification - Evolution of foraminifera - Stratigraphy of foraminifera with special reference to India - Biometrics of larger Foraminifera - Paleo Environmental interpretation using microfossils - Ostracoda - Nanofossils- Radiolaria-Conodonts.	13 Lectures
II	**Bryozoa - Role of micropaleontology in hydrocarbon exploration** - Deep sea records with reference to Indian Ocean - Stable isotopic study in foraminifera and interpretation of paleo temperature and paleo environment reconstruction.	13 Lectures
References	**Text Books:** 1. Anantharaman, M.S. (2005) Paleontology: Evolution and Animal Distribution, 6th edition, Vishal Publishing Co, New Delhi. 2. Bignot, G. (1985) Elements of Micropalaeontology. Graham and Trotman. **Reference Books:** 1. Haq, B.V. and Boersma, A., (1998) Introduction to Marine Micropalaeontology. Elsevier. 2. Haynes, J.R. (1981) Foraminifera. John Wiley.	
Course Outcomes	On completion of Course, the students should 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. Analyze the environmental and ecological significance of foraminifera and Ostracoda	

18GGMPO3M2

MICROPALEONTOLOGY (MODULAR COURSE)

CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	2	1	1	3	1	1	3	2	3	2	1
CO2	3	2	1	1	3	1	1	3	2	3	2	1
CO3	3	2	1	2	3	2	1	3	2	3	2	1
CO4	3	2	1	2	3	1	1	3	2	3	2	1
CO5	3	2	1	2	3	1	1	3	2	3	2	1

Course Code & Title	18GEOP419 **PETROLEUM GEOLOGY, COAL GEOLOGY AND GEOTHERMAL RESOURCES (Major Elective)**		
Class	M.Sc Geology and Geomatics	**Semester**	4th Semester
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • *To Describe the origin and mode of formation of hydrocarbon* • *To Learn about the geological conditions favoring the formation of hydrocarbon* • *To Know about the mode of occurrence of petroleum* • *To Understand the origin, properties, classification, and distribution of coal* • *To Gain knowledge on the various geothermal resources.*		

Unit	Content	No. of Hours
I	**Petroleum Geology**: Properties of petroleum: **Origin and Theories:** Organic and Inorganic Processes; **Environment of Oil Formation:** Sedimentary Basins - Continental and Offshore; **Migration and Accumulation of Petroleum;** Geological Factors Controlling Hydrocarbon Migration: Forces Responsible for Migration; Migration Routes and Barriers.	9 Lectures
II	***Mode of Occurrence of Petroleum: Surface and Subsurface Occurrence***. **Characteristics and Types of Reservoir Rocks:** Porosity, Permeability, and Reservoir Fluids; Petroleum Provinces; **Global Distribution of Petroleum Reserves-** ***Petroliferous Basins of India***. ***Well Logging,*** Mud logging method and usage in oil companies. Wire line logs, different types of wireline logs Identification of major minerals like oil and gas (Hydrocarbons), Coal.	9 Lectures
III	**Coal geology**: Physical Properties, Chemical Composition; Classification of Coal: Rank and Grade; Origin of Coal. **Lithologic characters of Coal:** Bed Structure, Coal Texture; Maceral Concept: Vitrain, Clarain, Durain and Fusain. Coke, **Coal for Liquefaction-** Coal bed methane, origin and occurrence; **Coal Gasification**- Beneficiation of Low-Grade Coal and Conservation.	9 Lectures
IV	**Occurrence of Coal: Geological and Geographical Distribution of Coal in India;** Detailed study of important Coal Fields in India; Neyveli Lignite Deposits; An Outline of Estimation of Coal Reserves. Identification of various lithology. Drilling method. **Coal and Environment.**	9 Lectures
V	**Geothermal Resources** – Geothermal Energy- Various Types, Availability, Size, Distribution-Recovery; Applications and Economics of Geothermal	9 Lectures

	Energy. **Mineralogy of the Nuclear Metals**; Distribution of U and Th in rocks; **Geochemical Guides-** Radiometric Prospecting Methods and Assaying; Bore Hole Logging, Field and Airborne Surveys	
References	**Text Books:** 1. Levorsen A.I., (1985) Geology of Petroleum, CBS Publishers and Distributors, Delhi, Second Edition, 2. Larry Thomas (2012), Coal geology, Wiley India Pvt. Ltd. 3. Mary.H.Dickson (2003) Geothermal energy utilization and technology **Reference Books:** 1. Alistarir R. Brown, (1986) Interpretation of Three-Dimensional Seismic Data, American Association of Petroleum Geologists, USA. 2. Aswathanarayana, U. (1985) Principles of Nuclear Geology. NBT. Delhi. 3. Gary L. Prost, (1997) Remote Sensing for Geologists - A Guide to Image interpretation, Gordon and Breach Science Publishers, The Netherlands. 4. Paine, D.P., (1986) Aerial photography and image interpretation for resource management, Wiley and Sons, New York. 5. Rao, D.P. (1999) Remote Sensing for Earth Resources, Second Edition, Association of Exploration Geophysicist, Hyderabad. **Web Resources:** 1. Underlined Titles are available in Swayam portal 2. http://petroleum.nic.in/sites/default/files/basins_0.pdf 3. https://www.ndrdgh.gov.in/NDR/?page_id=603 4. https://en.wikipedia.org/wiki/Petroleum 5. http://www.petroleum.co.uk/refining 6. http://www.eolss.net/sample-chapters/c01/e6-15-08-03.pdf 7. https://gis.gov.in/cs/groups/public/documents/document/b3zp/mtyx/~edisp/dcport/gsigovi161863.pdf 8. https://www.pmfias.com/coal-in-india-gondwana-coal-tertiary 9. https://geology.com/rocks/coal.shtml	
Course Outcomes	On completion of Course, the students should be able to 1. Explain the Formation, properties, Migration and accumulation of Petroleum. 2. Identify the Occurrences of Petroleum. 3. Explain the Characteristics of Coal. 4. Identify the Occurrences of Coal. 5. Predict the Geothermal Resources and uses.	

18GEOP419

PETROLEUM GEOLOGY, COAL GEOLOGY AND GEOTHERMAL RESOURCES (Major Elective)

CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	3	1	2	3	2	2	3	3	3	2	2
CO2	3	3	1	2	3	2	2	3	3	3	2	2
CO3	3	3	1	2	3	2	2	3	3	3	2	2
CO4	3	3	1	2	3	2	2	3	3	3	2	2
CO5	3	2	1	2	3	1	1	3	2	3	2	1

Course Code & Title	18GEOP420 **Dissertation**		
Class	M.Sc Geology and Geomatics	**Semester**	4th Semester
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	The students are allowed to work in various domains of geology and make them collect, process, analyze and interpret the data to bring out new results		

Course Code & Title	18GGMPO4M1 **GEOSTATISTICS (Modular Course)**		
Class	M. Sc Geology and Geomatics	**Semester**	4th Semester
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To Introduce the advanced and applied aspects of Mathematical Geology. • To Understand the Concepts of Geostatic and concepts of data distribution in space • To Learn about the concepts of correlation, exploratory spatial data analysis and interpolation		

Unit	Content	No. of Hours
I	**Geo statistics:** Meaning, Definition, and History of Geostatistics, **Spatial data**- Definition and Characteristics Types: Point pattern, continuous surfaces, Area with counts and aggregate rates, Terms in Spatial Analysis - **Definitions of** i. Spatial dependence, Stationary and Isotropy, Anisotropy, Region of stationary, Spatial correlation, Auto correlation, Corelogram. **Exploratory spatial data analysis:** ESDA/EDA - Meaning of Exploratory spatial data analysis (ESDA) and Exploratory data analysis (EDA). **Concepts of data distribution in space** - Data – i. Sampling, ii. Heteroginity, iii. Dependency, Univariate description. Frequency tables, Histogram, Cumulative frequency table, Normal probability plots. Summary / Descriptive statistics, Bivariate description - Scatter plot, correlation, covariance, correlation coefficient, linear regression.	13 Lectures
II	**Structural analysis**: Meaning / definitions -. i. Spatial correlation, ii. Autocorrelation, and iii. Spatial Autocorrelation, Spatial autocorrelation. Concept and "Moran's I" statistic, Correlogram - a. Concept, b. types: **Omni directional and directional**, Concepts of i. Autocovariance ii. Semivariances. iii. Semi variogram iv. Variogram: a. Components- Nugget variance, Sill, & Range. Variogram models. **Making predictions: Global interpolation - Local Interpolation – Practical Exposure on Exploratory spatial data analysis: Bivariate description. Spatial interpolation**	12 Lectures
	Text Books: 1. Sancheti. D. C. and Kapoor, V. K. (1992) Statistics Theory, Methods and Application. Sultan Chand & Sons publishers P.5.1 to 5.47 **Reference Books:** 1. Isaaks, E. H. and Srivastava, R.M., (1989) An Introduction to Applied Geo statistics,	

References	Oxford university Press, 2. Davis, J. C., (2002) Statistics and data analysis in geology, third edition, John Wiley & Sons, Singapore. 3. Using ArcGIS Geostatistical Analyst. (2001) GIS by ESRI. 4. Kitanidis P.K., (1997) Introduction to Geo statistics, Applications in Hydrogeology, Cambridge University Press. 5. Sharma, D. D, (2009), Geo statistics with applications in Earth sciences Jointly published with Capital Publishing Company. 6. Simon W., (2000) Houlding Geo statistics: Modeling and Spatial Analysis, Springer: Har/CdrEdition (8 June 2000), CD-ROM: 161 pages, 2000. 7. Cressie, N.A.C. (1993) Statistics for Spatial Data, New York: John Wiley & Sons, Inc. 8. Duetsch, C.V. and Journel, A.G. (1992), GSLIB: Geostatistical Software Library and User's Guide, New York: Oxford University Press, 9. Hohn, M.E. (1988) Geo statistics and Petroleum Geology, New York: Van Nostrand Reinhold, **Web Resources**: *1. http://people.ku.edu/~gbohling/cpe940/Variograms.pdf* *2. http://maps.unomaha.edu/Peterson/gisII/ESRImanuals/Ch3_Principles.pdf* *3. http://geofaculty.uwyo.edu/yzhang/files/Geosta1.pdf*
Course Outcomes	On completion of Course, the students should be able to **1.** Describe the principles of Geo statics **2.** Apply Geo statistics in geological data interpretation

18GGMPO4M1
GEOSTATISTICS (Modular Course)

CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	2	1	3	1	1	1	3	2	3	2	2
CO2	3	2	1	3	1	1	1	3	2	3	2	2

Course Code & Title	18GGMPO4M2 **ADVANCED HYDROGEOLOGY (Modular Course)**		
Class	M. Sc Geology and Geomatics	**Semester**	4th Semester
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To Introduce the advanced and applied aspects of hydrogeology. • To Understand the concepts of hydrologic cycle • To Interpret the role of geologic structures in identifying the potential zones of groundwater • To Describe the Characteristics of groundwater in arid, semi arid coastal as well as alluvial regions • To Know about the chemical characteristics of groundwater		

Unit	Content	No. of Hours
I	***Hydrologic cycle***. Hydrographic analyses, Water balance studies - Groundwater in hydrological cycle, Distribution of water in the Earth's crust - **Springs (including thermal):** origin and movement of water. Geologic structures favoring groundwater occurrence - Methods of identification of groundwater reservoir properties - Fluctuation of groundwater level	13 Lectures
II	**Groundwater in arid and semi-arid, coastal and alluvial regions** - Groundwater in hard rocks and limestone terrain with reference to Indian situation - **Chemical characteristics of groundwater** in relation to various uses- domestic, industrial and irrigation purposes - Water pollution and treatment. Environmental impact of groundwater extraction - Wells and their construction and design.	13 Lectures
References	**Text Books:** 1. David Keith Todd, Larry W. Mays, (2013) Groundwater Hydrology, wiley & sons. 2. Gurugnanam B. Essentials of Hydrogeology, First Edition, Publisher: New Sri Kumaravel. 3. Agarwal V.C., (2012) Groundwater Hydrology, Published by Asoke K. Ghosh, PHI Learning Private Limited, 4. Fetter C.W., Applied Hydrogeology, Second Edition, published by Satish Kumar Jain and produced by V.K. Jain for CBS Publishers & Distributer Pvt. Ltd., 5. Herman Bouwer, Groundwater Hydrology, 2014 Edition, Published by McGraw	

	Hill Education (India) Private Limited **Web Resources:** 1. *http://opac.vimaru.edu.vn/edata/EBookManual_of_applied_Field_Hydrogeology.pdfhttps://water.usgs.gov/ogw/pubs/TWRI3-B2/TWRI3-B2-with-links.pdf* 2. *http://unesdoc.unesco.org/images/0013/001344/134432e.pdf* 3. *http://www.basichydrogeology.com/HydrogeologyLectureNotes-v2.3-LR.pdf*
Course Outcomes	On completion of Course, the students should be able to 1. Describe about the Concepts of hydrogeology 2. Elaborate the characteristics of Groundwater

18GGMPO4M2

ADVANCED HYDROGEOLOGY (Modular Course)

CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	2	1	2	3	1	1	3	2	3	2	1
CO2	3	2	1	2	3	1	1	3	2	3	2	1

Courses offered to other Departments

Course Code & Title	18GEOP02N1 **INTRODUCTION TO GEOSCIENCES**		
Class	M.Sc Geology and Geomatics	**Semester**	For PG (3rd Semester)
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	The Course aims • To Understand the concept of geology, its scope and branches • To Know about the various crystal forms and symmetry, properties of various mineral groups • To Learn about the fossils, their morphology and their role in reconstructing the past environment as well as the major formations of India • To Gain knowledge about the different types of rocks, mode of formation, and their petrographic properties • To Elaborate the applications of geology in various other fields.		

Unit	Content	No. of Hours
I	**General Geology and Structural Geology:** Definition, scope and branches of Geology. **Origin of solar system:** Nebular and Planetesimal hypotheses. Brief description of earth's interior and the determination of age. Outline of plate tectonics, earthquakes, volcanoes and tsunami. Definition of Structural Geology. **Concept of rock outcrop** - dip and strike of rock formations. Definition, parts and important types of a fold and fault. Brief outline of joints and unconformities.	12 Lectures
II	**Crystallography and Mineralogy:** Definition of Crystallography and crystals. **Morphological characters of crystals:** faces – forms – edges. Symmetry elements of crystals. Miller's Indices. Brief account on crystal systems. Definition of mineralogy and mineral. **Outline of physical *properties of minerals*.** Brief description of the Quartz, Feldspar, Pyroxene, Amphibole, Mica group minerals. **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.	12 Lectures
III	**Paleontology and Stratigraphy**: Definition and importance of Paleontology and fossils. **Outlines of modes of preservation of fossils**, ***Cephalopods, Brachiopods***, Corals, ***Trilobites***. Definition and scope of Stratigraphy.	

	Geological Time Scale. Brief account of the following geological formations in India: Dharwar Group, Cuddapah Group, Vindhyan Group, Gondwana Group, Cretaceous formations of Tiruchirapalli.	12 Lectures
IV	**Petrology and Economic Geology:** Definition of Petrology and rock types. Important forms, structure and types of igneous, sedimentary and metamorphic rocks. **Brief description of the following igneous rocks:** granite, syenite, pegmatite, aplite, gabbro, dolerite, and basalt. Brief description of the following sedimentary rocks: sandstone, shale, and limestone. Agents of metamorphism. **Brief description of the following metamorphic rocks:** slate, phyllite, schist, gneiss, marble, quartzite, granulite, charnockite. Definition of Economic Geology. An outline of the processes of ore formation. Brief description of the physical properties and Indian occurrences of the important ores, minerals rocks used for various purposes. Coal Petroleum-composition, types and origin. Occurrence coal and petroleum deposits in India.	12 Lectures
V	**Applied Geology:** Introduction to geochemistry and geophysics. Principles of chemistry and physics applied to geology. Outline of geochemical and geophysical methods used for exploring the earth. Brief introduction about Nuclear Geology, Hydrogeology, Mining Geology, Engineering Geology and Environmental geology. Introduction and application of remote sensing and Geographic Information System.	13 Lectures
References	**Text Books:** 1. Parbin Singh, B., (2005) A Textbook of Engineering and General Geology S. K. Kataria & Sons, Delhi. 2. Mukherjee, P. K., (1984) A Textbook of Geology. World Press, Kolkata. 3. Lowrie, W., Fundamentals of Geophysics. 2nd edition **Reference Books:** 1. Mahapatra, G. B. (2000) General Geology. CBS Publishers, Delhi. 2. Bangar, K.M., (2009) Principles of Engineering Geology, CBS Publishers, Delhi. 3. Jain P.C and Anatharaman M.S., (2010) Palaeontology, Vishal Publishers.	
Course Outcomes	On completion of Course, the students should be able to 1. Describe about the Scope and importance of Geology 2. Explain about the characteristics of crystals symmetry and minerals 3. Discuss about the fossils 4. Categorize the rock types 5. Apply Geological knowledge in engineering aspects	

18GEOP02N1

INTRODUCTION TO GEOSCIENCES

CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	1	1	1	2	1	1	3	2	3	2	1
CO2	3	2	1	1	2	1	1	3	1	2	1	1
CO3	3	2	1	1	2	1	1	3	2	2	1	1
CO4	3	2	1	2	1	1	3	3	2	2	2	1
CO5	3	3	1	2	3	2	1	3	2	3	2	1

Course Code & Title	18GEOP02N2 **MEDICAL GEOLOGY**		
Class	M.Sc Geology and Geomatics	**Semester**	For PG (3rd Semester)
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To Know about the basic principles of medical geology • To Learn in detail about the Geological impacts of trace elements in nutrition • To Gain knowledge about the medicinal value of various minerals by understanding the physical and chemical properties.		

Unit	Content	No. of Hours
I	**Introduction to Medical Geology:** Medical Geology: Natural Distribution and Abundance of Elements, Functions of major and minor elements in human body, The functional value of Trace elements, Geological Impacts on Nutrition. **Magnesite;** Physical, chemical properties of Magnesite. Origin and Distribution of Magnesite in India. Uses of Magnesite. The role of Magnesite in Medical science.	12 Lectures
II	**Minerals Vs Medical science I: Gypsum;** Physical, chemical properties of Gypsum. Origin and Distribution of Gypsum in India. Uses of Gypsum. The role of Gypsum in Medical science. **Calcite;** Physical, chemical properties of Calcite. Origin and Distribution of Calcite in India. Uses of Calcite. The role of Calcite in Medical science. **Fossiliferous Limestone;** Physical, chemical properties of Fossiliferous Limestone. Origin and Distribution of Fossiliferous Limestone in India. Uses of Fossiliferous Limestone. The role of Fossiliferous Limestone in Medical science. **Red Ocher**; Physical, chemical properties of Red Ocher. Origin and Distribution of Red Ocher in India. Uses of Red Ocher. The role of Red Ocher in Medical science.	12 Lectures
III	**Minerals Vs Medical science II: Asbestos;** Physical, chemical properties of Asbestos. Origin and Distribution of Asbestos in India. Uses of Asbestos. The role of Asbestos in Medical science. **Sulphur;** Physical, chemical properties of Sulphur. Origin and Distribution of Sulphur in India. Uses of Sulphur. The role of Sulphur in Medical science. **Cinnabar**; Physical, chemical properties of Cinnabar. Origin and Distribution of Cinnabar in India. Uses of Cinnabar. The role of Cinnabar in Medical science. **Orpiment;** Physical, chemical properties of Orpiment. Origin and Distribution of Orpiment in India. Uses of	13 Lectures

	Orpiment. The role of Orpiment in Medical science.	
IV	**Minerals Vs Medical science III: Realgar;** Physical, chemical properties of Realgar. Origin and Distribution of Realgar in India. Uses of Realgar. The role of Realgar in Medical science. **Ferrogenous Shale;** Physical, chemical properties of Ferrogenous Shale. Origin and Distribution of Ferrogenous Shale in India. Uses of Ferrogenous Shale. The role of Ferrogenous Shale in Medical science. **Chalcanthite;** Physical, chemical properties of Chalcanthite. Origin and Distribution of Chalcanthite in India. Uses of Chalcanthite. The role of Chalcanthite in Medical science. **Rock Salt**; Physical, chemical properties of Rock Salt. Origin and Distribution of Rock Salt in India. Uses of Rock Salt. The role of Rock Salt in Medical science.	12 Lectures
V	**Minerals Vs Medical science IV: Borex;** Physical, chemical properties of Borex. Origin and Distribution of Borex in India. Uses of Borex. The role of Borex in Medical science. **Malachite and Azurite;** Physical, chemical properties of Malachite and Azurite. Origin and Distribution of Malachite and Azurite in India. Uses of Malachite and Azurite. The role of Malachite and Azurite in Medical science. **Salt Petre and Mica;** Physical, chemical properties of Salt Petre and Mica. Origin and Distribution of Salt Petre and Mica in India. Uses of Salt Petre and Mica. The role of Salt Petre and Mica in Medical science. **Hematite, Magnetite and Siderite**; Physical, chemical properties of Hematite, Magnetite and Siderite. Origin and Distribution of Hematite, Magnetite and Siderite in India. Uses of Hematite, Magnetite and Siderite. The role of Hematite, Magnetite and Siderite in Medical science.	13 Lectures
References	**Text Books:** 1. Sornamariammal (2016) Bogar Ezayiraththil Siddha Maruththuva Kanimangal. Published by World Siddha Trust. 2. Skinner C. H., and Berfer R. A., Geology and Health, 2000, Oxford University Press. **Reference Books:** 1. David Werner (1993) "Where there is no doctor", Reprinted, Macmillan. 2. Singh, R.Y., (2007) Geography of settlement, Reprinted, Rawat publications. 3. Purohit, N.J., (2014) Earth Science, Geology (Environmental and the Universe), 1st Edition, Swastik Publications, New Delhi, India 4. Gurugnanam, B., (2009) Essential of Hydrology, New India Publishing Agency, New Delhi, India. 5. Anji Reddy, (2010) Textbook of Remote Sensing and Geographical Information System, 3rd ed., BS publication.	
Course Outcomes	On completion of Course, the students should be able to 1. Explain about the Importance of Geology in Medicine and the characteristics and role of Magnesite in Medicine. 2. Use the knowledge of Gypsum, Calcite, Fossiliferous Limestone, Red Ocher and its application of this material in Medical Science. 3. Discuss the application of Asbestos, Sulphur, Cinnabar and Orpiment in medical science. 4. Outline the application of Realgar, Ferrogenous Shale, Chalcanthite, Rock Salt in medical science 5. Explain about the application of Borex, Azurite, Salt Petre and Mica, Hematite, Magnetite and Siderite in Medical Science.	

18GGMPO3M1
MEDICAL GEOLOGY (Modular Course)

CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	1	1	1	2	2	2	3	2	3	2	2
CO2	3	1	1	1	2	2	2	3	2	3	2	2
CO3	3	1	1	1	2	2	2	3	2	3	2	2
CO4	3	1	1	1	2	2	2	3	2	3	2	2
CO5	3	1	1	1	2	2	2	3	2	3	2	2

Course Code & Title	18GEOP02N3 **ENVIRONMENTAL GEOSCIENCES**		
Class	M.Sc Geology and Geomatics	**Semester**	For PG (3rd Semester)
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To Understand the importance of environmental geology • To Acquire knowledge about the concepts of ecosystem and resources • To Learn about the disaster their classification, cause and impacts • To Have a basic idea on various natural disasters • To Describe about the various approaches to the disaster risk reduction		

Unit	Content	No. of Hours
I	**Environmental Geology:** Planet Earth, environment and its types, scope and importance of Environmental Geology, public awareness, **Natural Resources;** types of resources (based on origin, based on continual utility). **Natural Resources and Associated Problems**: Forest resources, Water resources, Flood, Drought, Mineral resources	9 Lectures
II	**Energy Resources, Land resources, Ecosystem:** concept of an ecosystem, structure and function of an ecosystem, producers, consumers and decomposers, energy flow in the ecosystem, Ecological succession, food chains, food webs and Ecological pyramids. **Causes, Effects and Control Measures of:** Air Pollution, Soil Pollution, Marine Pollution, Noise Pollution, Thermal Pollution, Nuclear Hazards.	9 Lectures
III	***Introduction to Disaster*:** Concepts and Definitions. Disaster, Hazard, Risk, Vulnerability, Resilience. **Disaster: Classification, Causes and Impacts:** Natural Disaster: Beneath the Earth Surface: ***Earthquake*, Tsunami, *Volcanic Eruptions***.	9 Lectures
IV	***Natural Disaster*:** On the Surface: Landslides, Avalanche. **Meteorological / Hydrological Disasters;** Flood, Droughts, Windstorms, Hailstorms, Tornadoes, **Health; Epidemics.**	9 Lectures
V	**Approaches to Disaster Risk Reduction:** Disaster Management Cycle, Phases of Disaster Cycle. Culture of Safety, prevention, mitigation and Preparedness. Structural measures, Components of Disaster Relief. Four phases of Disaster Management	9 Lectures

References	**Text Books:** 1. Arul.P, (2011) Text Book of Environmental Studies, Selvi publications, Thanjavur. 2. Bangar, K.M(2010) Principles of Engineering Geology, Nem Chand Jain Publishers. 3. Savindra Singh., (2012) Environmental Geography, Prayag PustakBhawan. **Reference Books:** 1. Grija Bhushan Mahapatra, (1987) A Text Book of Geology, CBS Publishers and Distributors, New Delhi. 2. Jonathan Turk and Graham R. (2000) Thompson, Environmental Geoscience, Saunders college division. 3. Parbin Singh, (2009) A text book of Engineering and general Geology, publishers of engineering and computer books. 4. Pradyumna, P. Karan, Shanmugam, P. Subbiah (2012): The Indian Ocean tsunami, Cambridge University press India Pvt. Ltd. 5. Santra S.C, (2004) Environmental Science, New central book agency. 6. Thomas D. Schneid, (2001) Disaster Management and Preparedness" Tata McGraw Hill, New Delhi. 7. Vinod K. Jain, (2005) Earth Science, CBS Publishers and Distributors, New Delhi.
Course Outcomes	On completion of Course, the students should be able to 1. Describe about the importance of Environmental Geology 2. Discuss about the resources and Ecosystem 3. Elaborate the concepts of Disaster 4. Explain about the Natural Disaster 5. Summarize the approaches to disaster risk management

18GEOP02N3

ENVIRONMENTAL GEOSCIENCES

CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	1	1	1	2	1	2	3	3	3	2	2
CO2	3	1	3	2	2	1	1	3	3	2	2	2
CO3	3	2	3	2	2	1	1	3	1	2	2	2
CO4	3	2	3	2	2	1	1	3	1	2	2	2
CO5	3	2	3	2	2	1	1	3	1	2	2	2

Course Code & Title	18GEOP02N4 **DISASTER MANAGEMENT**		
Class	M.Sc Geology and Geomatics	**Semester**	For PG (3rd Semester)
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To Understand the various geological processes • To Have broad idea about disaster and its characteristics • To Know about the cause, impacts and preventive measures for cyclones and storm surges • To Describe about the cause and impacts of flood and drought • To Elaborate the cause and impacts of Earthquake, landslides, volcanic eruption, Tsunami		

Unit	Content	No. of Hours
I	**Geosciences and Natural Disasters**: Origin of the Earth, Interior of the Earth. Endogenic processes and exogenic processes of the Earth. **Disaster;** Disaster and its relation with Nature and Socio-Economic Factors. ***Types of Disasters***, **Disaster Management; An Introduction, Disaster Management Cycle**. **Hazard Vulnerability Terminology**	13 Lectures
II	**Disaster and Geology; Category Vise Disaster in India, Disaster and Geography;** Disaster from Anthropocentric viewpoint, Natural system, Earth as a Dynamic system. Mass Extinction History. **Atmosphere and its Layers:** Weather and Atmosphere, Schematic of Climate system. Differential heating of earth and the season. **Monsoons – Source of life and Disaster in India. Monsoons and Rainfall in India. El Nino and La Nina and Extreme weather:** Impact of this in India	13 Lectures
III	**Natural Disaster I: Cyclones;** Definition and the Mechanics of cyclone. Birth of Cyclone, Tropical Cyclone Hazard Map, Cyclone Date goryes, Cyclone Disaster Impacts. **Strong Winds, Torrential Rains, Strom Surges;** Impact of Strom surges in India. **Disaster Management During Cyclone. Indian Government and Cyclone disaster management. Cyclone Warning Centers in India.**	13 Lectures
IV	**IV Natural Disaster II; Floods;** Occurrence of Flood in India, Peninsular Rivers, Flood Hazard Zones, Causative Factors for Flooding, Managing Floods**;** Before Floods and During Floods. **Drought as Disaster in India;** Types of	13 Lectures

	Droughts, Rainfall Deficit Map. Impact of this on GDP.	
V	**Natural Disaster III: Earthquakes**: Basic Tectonics and Earth Quakes, Tectonic Plates, Earthquakes and Tectonic Plates, Earthquakes in India, Earthquake Magnitude (Richter) and Effects, Richter and Mercalli Scales. Earthquake Disaster Management in India. Possible Safety measures in an Earthquake. **Landslides;** Landslide Hazard in India, Landslides Disaster Management and Worst Landslides in India, Landslide Warning Signs, what to do in Landslides. **Volcanoes, Tsunami Disaster**, **Cyclone Disaster. Drought Disaster** and its management, and **climate change** and its management. Other disasters and their management. **Flood Hazard**. Occurrence of Floods in India. **Biological Disasters.**	13 Lectures
References	**Text Books:** 1. Bangar, K.M Principles of Engineering Geology, Nem Chand Jain Publishers, 2010. 2. Parbin Singh, (2009) A text book of Engineering and general Geology, publishers of engineering and computer books, 3. Mukerjee.P.K (1997) A textbook of Geology,. Thirteenth Edition. The world press pvt. Ltd **Reference Books:** 1. Mahapatra, G. B., (1987) A Text Book of Geology, CBS Publishers and Distributors, New Delhi, 2. Jonathan Turk and Graham R. Thompson, (2000) Environmental Geosciences, Saunders college division. 3. Pradeep Sahni, Madhavimalalgoda and Ariyabandu, "Disaster risk reduction in south Asia". PHI 4. Pradyumna, P. Karan, Shanmugam, P. Subbiah.,2012 The Indian Ocean tsunami, Cambridge University press India Pvt. Ltd. 5. Santra S.C, (2004) Environmental Science, New central book agency. 6. Thomas D. Schneid, (2001) Disaster Management and Preparedness" Tata McGraw Hill, New Delhi. 7. Vinod K. Jain, Earth Science, (2005) CBS Publishers and Distributors, New Delhi. 8. Janet Edwards and Martin Gustafs son (2007) Handbook for Vulnerability Mapping. Serdish Rescue Services Agency.	
Course Outcomes	On completion of Course, the students should be able to 1. Explain Geosciences and the importance of Disaster 2. Describe about the disaster distribution in India, Atmosphere and monsoon vs disaster. 3. Have deeper knowledge on Cyclones and Strom, Floods and Drought, Earthquake, Volcanoes and Landslides	

18GEOP02N4
DISASTER MANAGEMENT

CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	1	1	1	2	1	2	3	3	3	2	2
CO2	3	1	3	2	2	1	1	3	3	2	2	2
CO3	3	2	3	2	2	1	1	3	1	2	2	2
CO4	3	2	3	2	2	1	1	3	1	2	2	2
CO5	3	2	3	2	2	1	1	3	1	2	2	2