B.Sc., Geology

Syllabus

w.e.f. 2018 Onwards

Centre for Applied Geology

Gandhigram Rural Institute (Deemed to be University)

Scheme of Examinations										
Sem.	**Category**	**Course Code**	**Title of the course**	**Credits**	**Hours**			**CFA**	**ESE**	**Total**
					L	**P**	**E**			
I	Language I (Part- I)	18TAMU0101/ 18HIDU0101/ 18MALU0101/ 18FREU0101	Tamil/Hindi/Malayalam / French	3	3	-	-	40	60	100
	Language II (Part- II)	18ENGU01F1	English	3	3	-	-	40	60	100
	(Part- IV)	18NSSU0001/ 18FATU0001/ 18SPOU0001	NSS/FA/Sports		1	-	-	50	-	50
	(Part- IV)	18YOGU0001	Yoga	1	1	-	-	50	-	50
	(Part- V)	18EVSU0001	Environmental Studies	4	3	2	-	40	60	100
	Allied course (Part- III)	18MATU01A1	Allied Mathematics – I	4	4	-	3	40	60	100
	Core Courses (Part- III)	18GEOU0101	General Geology	3	3	-	3	40	60	100
		18GEOU0102	Geomorphology	3	3	-	3	40	60	100
		18GEOU0103	Survey - Practical	1	-	1	3	60	40	100
			Total	**23**						

Sem.	**Category**	**Course Code**	**Title of the course**	**Credits**	**Hours**			**CFA**	**ESE**	**Total**
					L	**P**	**E**			
II	Language I	18TAMU020	Tamil/Hindi/	3	3	-	-	40	60	100

	(Part- I)	2/ 18HIDU0202 / 18MALU0202/ 18FREU0202	Malayalam / French							
	Language II (Part- II)	18ENGU02F2	English	3	3	-	-	40	60	100
	Language-III (Part- IV)	18CHIU0001 / 18CTAU0001 / 18CMALU0001	Core Hindi/ Core Tamil/Core Malayalam	2	2	-	-	20	30	50
	(Part- V)	18GTPU0001	Gandhian Thought	2	2	-	-	20	30	50
	(Part- V)	18EXNU0001	Extension Education	2	2	-	-	20	30	50
	Soft Skills (Part- IV)	18ENGU00C1	Communication & Soft skills	2	2	-	-	20	30	50
	Allied Course (Part- III)	18MATU02A2	Allied Mathematics – II	4	4	-	-	40	60	100
	Core Courses (Part- III)	18GEOU0204	Structural Geology	3	3	-	3	40	60	100
		18GEOU0205	Stratigraphy	3	3		3	40	60	100
		18GEOU0206	Structural Geology - Practical	1	-	3	3	60	40	100
			Total	**25**						

Sem.	Category	Course Code	Title of the course	Credits	Hours			CFA	ESE	Total
					L	P	E			
III	Language I (Part- I)	18TAMU0303/ 18HIDU0303/ 18MALU0303/ 18FREU0303	Tamil/Hindi/ Malayalam / French	3	3	-	-	40	60	100
	Language II (Part- II)	18ENGU03F3	English	3	3	-	-	40	60	100
	Language – III (Part- IV)	18CTAU0002 / 18CHIU0002 / 18CMLU0002	Core Hindi/ Core Tamil/ Core Malayalam	2	2	-	-	20	30	50
	(Part- V)	18SHSU0001	Shanthi Sena	1	-	2	-	50	-	50
	Computer Skill (Part- IV)	18CSAU03A1	Computer Fundamentals and office automation	4	3	2	-	40	60	100
	VPP (Part- V)	18EXNU03V1	VPP	2	-	-	-	50	-	50
	Allied Course (Part- III)	18PHYU03A1	Allied Chemistry – I / Allied Physics - I	3	3	-	-	40	60	100
			Allied Chemistry - Practical - I / Allied Physics- Practical - I	1	-	3	-	20	30	100
	Core Courses (Part- III)	18GEOU0307	Paleontology	3	3	-	3	40	60	100
		18GEOU0308	Paleontology - Practical	1	-	3	3	60	40	100
	Part- III	18GEOU0309	Geological Field Study	1	-	3	-	50	-	50
			Total	**24**						

Sem.	Category	Course Code	Title of the course	Credits	Hours			CFA	ESE	Total
					L	P	E			
IV	Allied course (Part- III)	18PHYU04A2	Allied Physics – II/ Allied Chemistry - II	3	3	-	-	40	60	100

		18PHYU04A3	Allied Physics-Practical – II/ Allied Chemistry - Practical - II	1	-	3	-	20	30	50
	Non-major elective (Part- III)			3	3	-	-	40	60	100
	Major elective (Part- III)	18GEOU04EX		3	3	-	-	40	60	100
	Core courses (Part- III)	18GEOU0410	Crystallography	3	3	-	3	40	60	100
		18GEOU0411	Mineralogy	3	3	-	-	40	60	100
		18GEOU0412	Crystallography - Practical	1	-	3	-	60	40	100
		18GEOU0413	Mineralogy – Practical	1	-	3	-	60	40	100
	Part- III	18GEOU0414	Geological Field Study	1	-	3	-	50	-	50
			Total	**19**						

Sem.	**Category**	**Course Code**	**Title of the course**	**Credits**	**Hours**			**CFA**	**ESE**	**Total**
					L	**P**	**E**			
V	Skill Based Elective (Part- III)	18GEOU05SX		2	2	-	-	40	-	
	Non-Major Elective (Part- III)			3	3	-	-	40	60	100
	Major Elective (Part- III)	18GEOU05EX		3	3	-	3	40	60	100
	Core Courses (Part- III)	18GEOU0515	Igneous and Metamorphic Petrology	4	4	-	3	40	60	100
		18GEOU0516	Sedimentary Petrology and Marine Geology	4	4	-	3	40	60	100
		18GEOU0517	Igneous Petrology - Practical	1	-	3	3	60	40	100
		18GEOU0518	Metamorphic and Sedimentary Petrology – Practical	1	-	3	-	60	40	100
	(Part- III)	18GEOU0519	Geological Field Study	1	-	6	-	50	-	50
			Total	**19**						

Sem.	Category	Course Code	Title of the course	Credits	Hours			CFA	ESE	Total
					L	P	E			
VI	Modular courses	15GEOU06MX	Introduction to Field Geology	2	2	-	-	50	-	50
	Modular courses	15GEOU06MY	Geological Mapping	2	2	-	-	50	-	50
	Project (Part- III)	18GEOU0620	Dissertation	4	-	4	-	40	40 +20	100
	Core Courses (Part- III)	18GEOU0621	Economic Geology	4	4	-	-	40	60	100
		18GEOU0622	Coal and Petroleum Geology	4	4	-	-	40	60	100
		18GEOU0623	Applied Geology	4	4	-	-	40	60	100
		18GEOU0624	Economic Geology - Practical	1	-	3	-	40	60	100
		18GEOU0625	Geological Field Study	1	-	3	-	50	-	50
			Total	**22**						

Major Electives							
Course Code	**Paper Title**	**L /T**	**P**	**E**	**CFA**	**ESE**	**C**
18GEOU04E1	Introduction to Remote Sensing	3	-	3	40	60	3
18GEOU04E2	Hydrogeology	3	-	3	40	60	3
18GEOU05E1	Mining Geology	3	-	3	40	60	3
18GEOU05E2	Earth and Climate	3	-	3	40	60	3

Courses Offered from Centre for Applied Geology							
Course Code	**Paper Title**	**L /T**	**P**	**E**	**CFA**	**ESE**	**C**
18GEOU03N1	Engineering Geology	3	1	3	40	60	4
18GEOU04N1	Disaster Management	3	-	3	40	60	3
18GEOU04N2	Applied Geology	3	-	3	40	60	3
18GEOU05N1	Environmental Geosciences	3	-	3	40	60	3

Course Syllabus

Course Code & Title	**18GEOU0101** **General Geology**		
Class	**B. Sc Geology**	**Semester**	**I**
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To Know about the basic principles of Geology and the solar system and its components • To Demonstrate about the various processes of the Earth • To Illustrate about the period-based history and its formations. • To Describe about the geological processes of weathering. • To Summarize the concept of Plate tectonics		

Unit	Content	No. of Hours
I	**Geology:** Earth Sciences, Subdivisions of Geology, Allied Sciences, ***Scope of Geology***. **The Steller System – The Solar System –**Grouping of planets – ***The Inner or Terrestrial Planets***, The Outer Planets. **Planets:** Description and details of inner planets (Mercury, Venus, Earth and Mars), and outer plants (Jupiter, Saturn, Uranus, Neptune and Pluto) – **Physical data of planets**. **Parts of the Earth: The Atmosphere:** Troposphere, Stratosphere, Mesosphere, Thermosphere, Lithosphere and Hydrosphere.	12 Lectures
II	***Origin of the Earth*: Description of the origin, Fundamental Regularities, Theories of Origin –** The Nebular hypothesis – The Tidal Hypothesis – The Gas-Dust cloud hypothesis–Weizascker's Hypothesis – Schmidit's Hypothesis–Hoyle's Magnetic Theory. ***Age of Earth*:** Old Methods, New Methods, Disintegration constant, Half Life – Uranium-Lead Method, Rubidium-Strontium Method, Lead- Lead Method, Meteoric Lead Method	12 Lectures
III	**Geological Time Scale.** ***Internal Structure of the Earth:*** Description, Seismological Evidence – Basic facts, Interpretation, Final Picture. **The Crust:** Mountainous Areas, Continental Areas, Oceanic Areas, Continental Crustal Layers– Diagrammatic representation of structure of earth crust. **The Mantle, The Core:** Inner shell, Outer shell. **Internal Structure of the earth (Diagrammatic representation with its composition details).**	12 Lectures

IV	**Rock Weathering:** Description, **Mechanical** (**Physical) Weathering**: Frost Action, Thermal Effects (Insolation), Unloading - ***Chemical weathering:*** Description, Solution, Hydration and Hydrolysis, Oxidation and Reduction, Carbonation, Colloid Formation, Spheroidal weathering. **Role of Plants and Organisms. Factors Affecting Weathering, Resistance to Weathering.** ***Products of Weathering*-** Regolith, Soil Profile, Mineral and Rock formation.	12 Lectures
V	**Plate Tectonics:** ***Theory of Plate Tectonics*. The lithosphere Plates. Movement of Plates:** Divergent Boundaries, Convergent Boundaries, Transform Boundaries. **Global Effects.** ***Earthquakes*:** Description, Classification, Causes and Effects of Earthquake. ***Volcanoes*:** Description, Materials of Volcanoes, Types of Eruption, Distribution and Origin and Volcanic Landscape**.**	12 Lectures
References	**Text Books:** 1. Radhakrishnan, V., General Geology, V.V.P. Publishers, Tuticorin, 1996. 2. Mahapatra, G.P., Textbook of Geology, CBS Publishers, New Delhi, 1992. **Reference Books:** 1. Holmes, A & P. L. Duff, Principles of PhysicalGeology, 4th revised edition, ELBS, London,1996. 2. Mukherjee, A. K. Principles of Geology, EW Press,Kolkata, 1990. 3. Parbin Singh,B. A Textbook of Engineering and General Geology. S. K. Kataria & Sons.Delhi, 2005. 4. Porter, S. C.& B.J. Skinner, The Dynamic Earth,John Wiley & Sons, NewYork, 1995. Leet, D & Judson, S. Physical Geology, McGraw Hill, New Jersey, 1987. 5. Zumberge, J. Physical Geology, Freeman, New York,1980. 6. Underlined Titles are available in Swayam portal. **Web Resources:** 1. *https://opentextbc.ca/geology/chapter/1-1-what-is-geology/* 2. *https://www.nap.edu/read/6024/chapter/3* 3. *https://simple.wikipedia.org/wiki/Structure_of_the_Earth* 4. *https://www.clearias.com/interior-of-the-earth/* 5. *https://www.nationalgeographic.org/encyclopedia/weathering/* 6. *https://www.livescience.com/37706-what-is-plate-tectonics.html* 7. *https://www.britannica.com/science/plate-tectonics* 8. *https://www.nationalgeographic.com/environment/naturaldisasters/volcanoes/*	
Course Outcomes	On completion of Course, the students should be able to 1. Discuss about basics of Geology, Solar system and Atmosphere 2. Evaluate the Theories of Origin of Earth and Age of the Earth 3. Demonstrate the Geological time scale and Internal structure of the Earth 4. Explain the agents of weathering and its products 5. Discuss the theory of plate tectonics and demonstrate the causes of Earthquakes and volcanoes.	

18GEOU0101 - General Geology												
CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	1	1	3	2	1	0	3	3	1	3	2
CO2	3	1	1	3	2	1	1	3	2	2	3	1
CO3	3	1	1	3	1	1	3	3	2	1	3	1
CO4	3	2	1	3	1	1	2	3	2	3	3	2
CO5	3	2	1	3	2	1	2	3	3	3	3	3

Course Code & Title	**18GEOU0102 Geomorphology**		
Class	**B. Sc Geology**	**Semester**	**I**
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To Generalize the Concept of Geomorphology • To Describe the Geological work of River • To Demonstrate the Geological work of Groundwater • To Evaluate the Geological work of Glaciers • To Learn about the Morphology of ocean.		

Unit	Content	No. of Hours
I	**Geomorphology**: **Definition and concept of geomorphology- Mass wasting:** Definition, classification - slow flowage, rapid flowage, sliding and subsidence; products – Colluvium and Talus. ***Geological work of Wind*:** Wind Erosion and its landforms, sediment transport by wind, and its landforms, deposition by wind and its landforms - Sand dunes and their types.	12 Lectures
II	***Geological work of River*:** Sources of stream water – River profile – Geological work – Methods of river erosion – rate of river erosion – features of stream erosion –sediment transport by river, deposition by river. **Lakes**: Description, classification, origin, geological function, distribution and Indian lakes.	12 Lectures
III	**Geological work of Groundwater:** Description, Chemical Work of Groundwater, Deposition by Groundwater, Mechanical Work of Groundwater. **Drainage patterns and its types**. **Major rivers in India.**	12 Lectures
IV	**Geological work of Glaciers:** Glacial morphology – Types of glaciers – Geological work of glaciers – glacial erosion – rate of glacial erosion – features of glacial erosion – glacial transport and glacial deposits – Morphological notes on glacial deposits.	12 Lectures
V	***Geological work of Sea*:** Definition of continental shelf, continental slope, abyssal plain, continental rise and submarine canyons. Marine erosion and features of marine erosion – Marine deposition – Coral reefs.	12 Lectures
	Text Books: 1. Radhakrishnan, V., General Geology, V.V.P. Publishers, Tuticorin, 1996. 2. Mahapatra, G.P., Textbook of Geology, CBS Publishers, New Delhi, 1992. **Reference Books:**	

References	1. *Worcester, P. G., A Text Book of Geomorphology, East West Press Ltd. Delhi, 1960.* 2. *Thornbury, W. D., Principles of Geomorphology, John Wiley and Sons, 2nd Edition, New York. 2002.* 3. *Singh, S. Geomorphology. S. Chand &Co.Delhi, 2007.* 4. *Park, R. G, Foundation of Structural Geology, Blackie and Sons Ltd., Glasgow, NewZealand, Second edition,1989.* 5. *Davis, G. H., Structural Geology of Rocks and Regions. Elements of Structural geology, Wiley, 1985.* 6. *Underlined Titles are available in Swayam portal.* **Web Resources:** 1. http://geomorphology.org.uk/what-geomorphology-0 2. http://geographymat.blogspot.com/2011/02/fundamental-conecpts.html 3. http://www.preservearticles.com/2011110116387/what-is-the-gological-action-of-river.html 4. http://www.alevelgeography.com/the-long-profile-changing-processes-types-of-erosion-transportation-and-deposition/ 5. http://www.preservearticles.com/2011110116404/what-is-the-geological-action-of-the-underground-water.html 6. http://www.preservearticles.com/2011110116411/what-are-the-geological-action-of-glaciers.html 7. http://www.preservearticles.com/2011110116424/what-are-the-geological-activities-of-the-sea-a-oceans.html
Course Outcomes	On completion of Course, the students should be able to 1. Outline about the concept of geomorphology and geological work of wind 2. Demonstrate the landforms created by river and lakes. 3. Evaluate the landforms created by Groundwater and describe about drainage pattern 4. Explain about the landforms developed by glaciers 5. Demonstrate about the geological work of sea.

18GEOU0102 - Geomorphology												
CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	1	2	3	1	1	2	3	2	2	2	3
CO2	3	2	1	3	2	1	2	3	3	2	3	3
CO3	3	1	3	3	1	1	3	3	3	3	2	3
CO4	3	1	2	2	2	1	2	3	2	2	3	3
CO5	3	1	2	3	1	1	2	3	2	2	2	3

Course Code & Title	**18GEOU0103** **Survey Practical**		
Class	**B. Sc Geology**	**Semester**	I
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To introduce the basic surveying techniques relevant to Geological mapping and mining geology. • To know the operational process of the survey equipment's.		

Unit	**Contents**
	1. Definition – Primary divisions – classification 2. Chain survey – description of instruments employed – chain traverse - Open traverse and closed traverse 3. Compass survey – description of prismatic compass – whole circle bearings – reduced bearings – quadrant bearings 4. Plain table surveying: Finding distance between inaccessible stations 5. Locating the instrument station – Clinometer compass. 6. Finding dip and strike of beds 7. Modern Surveying. 8. Levelling: Rise and Fall method 9. GPS: Fundamentals and applications. 10. Surveying using GPS.
Course Outcomes	On completion of Course, the students should be able to *1. Demonstrate the various types of surveying* *2. Identify the distance between two points* *3. Assess the true dip and strike* *4. Use the GPS for survey.* *5. Evaluate the various terrains.*

18GEOU0103 - Survey Practical												
CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	3	3	3	3	3	2	3	2	3	2	1
CO2	3	3	3	3	3	2	1	3	1	1	1	1
CO3	3	3	3	3	3	2	2	3	1	2	1	1
CO4	3	3	3	3	3	2	1	3	2	1	1	1
CO5	3	3	3	3	3	3	2	3	2	3	2	2

Course Code & Title	**18GEOU0204** **Structural Geology**		
Class	**B. Sc Geology**	**Semester**	**II**
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To understand the of different structures in crustal rocks derived from various forces active on and within the Earth's crust. • To Describe the mechanism of faults. • To Classification of faults • To Demonstrate the mechanics of Joints and Unconformities • To Describe Foliation and lineation		

Unit	Content	No. of Hours
I	**Introduction to Structural Geology:** Primary and secondary structures – Outcrop – Bedding stratification – *Dip and strike* – *Apparent and true dip* –types of dip – outcrop dimension – intrusions – flows and masses. ***Folds*:** **Parts of folds**: Limb, Hinge, Axis of fold, Plunge of fold, crust and trough. ***Classification of fold***: Anticline, Syncline, based on axial plane and based on compression.	12 Lectures
II	***Fault:*** General Characteristics – Nature and Movement along faults – ***Classification of faults*** – Criteria for faulting: Introduction – Discontinuity of structures – Repetition and omission of strata– Features and characteristics of fault planes – Silicification and mineralization. **Distinction between fault scraps – fault line scraps and composite fault scraps. Normal faults:** Introduction – size – attitude and pattern – Tilted fault blocks – Horst and graben – Modern faults- Renewed faulting – **Mechanics of normal faulting**.	12 Lectures
III	**Reverse faults, thrust faults and over thrusts**: Introduction – Thrusts and reverse faults – Over thrusts – Detachment of faults – Mega breccias – **Mechanics of reverse, thrust and over thrust faulting**. **Strike-slip faulting:** Introduction – Rate of displacement – Fracture zone on the ocean basins – **Mechanics of strike-slip faults, dip slip faults**	12 Lectures
IV	***Joints:*** *Definition* – ***Classification and Geometry of Joints*** – Genesis: Tension joints – Shear joints – Compression joints – **Occurrence of joints**: Igneous rocks: Sheet joints – Mural joints – columnar joints – Sedimentary rocks and Metamorphic rocks – Origin of joints: Contraction during formation – Expansion and contraction – crustal disturbance.	12 Lectures

	Unconformities: *Definition* ***– Origin – Types*****:** Angular Unconformity – Disconformity – Nonconformity – Local Unconformity – Regional Unconformity – Detection of Unconformity **- Distinguishing faults from unconformities**– Radiogenic dating – Tectonism and sedimentation.	
V	**Origin of fissility, cleavage, schistocity and foliation:** Slaty cleavage– fracture cleavage – slop cleavage – bedding cleavage **– *Origin of foliation*.** Breccias and auto clastic structures**. *Lineation*:** Kinds of secondary lineation – origin – successive lineation.	12 Lectures
References	**Text Books:** 1. Billings, M. P. Structural Geology. Prentice Hall of India Ltd. New Delhi, 1974. 2. Gokhale, N.W., Theory of Structural Geology, CBS publications, Delhi, 2010. 3. Parbin Singh, B., A Textbook of Engineering and General Geology, K.Kataria & Sons. Delhi, 2005. **Reference Books:** 1. Sathya Narayanaswami, B. S., Structural Geology. Dhanpat Rai & Sons.New Delhi, 1994. Davis, G.H., and S.J., Reynolds., Structural Geology of Rocks and Regions, 2nd ed., Wiley, NewYork, 1996. 2. Gokhale N W, Theory of structural geology., CBS Publications, 2009. 3. Hobbs, B. E., Means, W. D., & Williams, P. E. An Outline of Structural Geology, John Wiley& Sons, Inc, Australia 1976. 4. *Underlined Titles are available in Swayam portal.* **Web Resources:** 1. http://www.geosci.usyd.edu.au/users/prey/Patrice_Intro_to_SG.pdf 2. https://www.geoexpro.com/articles/2013/07/folds-and-folding-part-i 3. https://www.aboutcivil.org/faults-geological-faults-in-earth.html 4. http://www.yourarticlelibrary.com/geology/faults-meaning-classification-and-importance-geology/91572 5. http://www.geographynotes.com/geology-2/structural-geology/joints-definition-classification-and-consideration-geology/1375 6. http://www.indiana.edu/~geol105b/images/gaia_chapter_6/unconformities.html/	
Course Outcomes	On completion of Course, the students should be able to 1. Explain about primary and secondary structures and fold 2. Demonstrate and classify the faults in the field 3. Evaluate the types faults 4. Discuss about Joints and Unconformities *5.* Demonstrate the origin of foliation and lineation	

18GEOU0204 - Structural Geology												
CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	2	2	3	2	1	2	3	2	2	2	3
CO2	3	1	2	3	1	1	2	3	1	2	1	2
CO3	3	2	2	3	2	1	1	3	1	2	1	2
CO4	3	1	2	3	1	1	1	3	1	2	1	2
CO5	3	1	2	3	2	1	1	3	1	2	1	2

Course Code & Title	**18GEOU0205** **Stratigraphy**		
Class	**B. Sc. Geology**	**Semester**	**II**
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To learn about the geological time scale and principles of stratigraphy • To Describe proterozic stratigraphy of Indian sub-continent • To Explain Palaeozoic Group of Indian stratigraphy. • To Discuss Mesozoic age group of Indian Stata. • To Summarize the Origin of Deccan traps		

Unit	Content	No. of Hours
I	Stratigraphy – Definition, Laws of stratigraphy. ***Principles of correlation*** – Objectives – Elements of correlation – Standard stratigraphic scale – Order of superposition, Geological Timescale, Indian Geological Timescale, Faces and Faces Change, Break in Records. Physiographic Divisions of India. The Himalayas. **Lithological and structural controls**: Bio stratigraphic controls – Lithostratigraphic controls – Radioactive dating control – Difficulties in correlation. **The Archean Group**: Introduction – Distribution – **Lithology**: Bundelkhand gneiss – Charnockite series – Gneiss: Champion gneiss – Peninsular gneiss – Schist. **Dharwar System**: Definition and distribution – Lithology – Classification Lower Dharwar – Middle Dharwar – Upper Dharwar– Life and Economic importance of Archean group. Archean rocks of TamilNadu, economic mineral deposits**.**	11 Lectures
II	**Proterozoic group: The Cuddapah System**: Definition and distribution – **Cuddapah Basin of Andhra**: Kistna series – Nallamalai series – Cheyair series – Papaghani series. Cuddapah rocks of Madhya Pradesh – The Delhi System - Economic minerals of Cuddapah system. **The Vindhyan System**: Definition and distribution – Lithology – Life – **Stratigraphic classification of Vindhyan System**: Upper Vindhyan – Lower Vindhyan – Kurnool system- Economic minerals of Vindhyan system.	11 Lectures
	Palaeozoic Group: Introduction – **The Cambrian system**: Definition and Distribution – Cambrian of Spiti (Haimanta system) – Lithology-	11 Lectures

III	Classification: Upper Haimanta, Middle Haimanta and Lower Haimanta– Life – The Cambrian of Kashmir – Cambrian of Salt range. **The Ordovician system**, **The Silurian System and Devonian System. The carboniferous system:** Carboniferous of Spiti – Carboniferous of Kashmir**. The Permian System:** Kashmir – Salt range**.**	
IV	**Mesozoic Group:** Introduction – The Mesozoic of Tethys Himalaya. **The Triassic System**: Spiti- Definition – Lithology – Classification: Keuper – Muschelkalk - Bunter – Life. Kashmir: Lithology – Classification: Upper Triassic- Middle Triassic – Lower Triassic – Life. Salt range. **The Jurassic System**: Spiti – Kashmir – Salt range- The Jurassic of Kutch: Patcham series – Chari series – Katrol series – Umia series. **The Cretaceous system:** Definition and distribution – The marine facies of cretaceous system – The Coromandal coast – Cretaceous of Narmada valley – Marine cretaceous of Extra- Peninsula – Origin of Marine cretaceous – The Fluviatile Cretaceous (Lameta series).	11 Lectures
V	***Deccan Traps:*** Definition and distribution – Petrology – Structural features – Classification: Upper traps- Middle traps – Lower traps – Life – Origin – Age. **The Gondwana group**: Introduction – Distribution – Classification –Upper Gondwana – Middle Gondwana – Lower Gondwana – Lithology – Life – Economic importance. **Cenozoic Group: The Tertiary group;** Introduction – Distribution – Tertiary group of extra peninsulas–Cuddalore sandstone. **The Eocene system**; Definition and distribution – lithology – Life. **The Oligocene- Lower Miocene systems** – **The Siwalik system**: Definition and distribution – Lithology – classification – Life – structure – Origin – **The Pleistocene system**: Definition and distribution – Indo-gangetic alluvium – lithological characters – Origin	11 Lectures
References	**Text Books:** 1. Krishnan, M. S., Geology of India, Burma and Pakistan. CBS. New Delhi, 1986. 2. Mehdiratta, R. C., Geology of India, Pakistan, Bangladesh and Burma. Atma Ram & Sons. Delhi,1974. 3. Kumar, R. Fundamentals of Historical Geology and Stratigraphy of India, Wiley, New Delhi, 1988. **Reference Books:** 1. Wadia, D.N. Geology of India. McMillan India. Delhi,1953. 2. Boggs, S. Principles of Sediment logy and Stratigraphy, Merrill Publishing Co. New York. 1987 3. Weller. A.K. Principles of Stratigraphy. Asia Publishing House. Delhi. 1988. 4. Gignoux, M, Stratigraphical Geology, Mc Graw hill publications, 1960. 5. Underlined Titles are available at Swayam portal. **Web Resources:** 1. http://eps.mcgill.ca/~courses/c240/W3_L1.pdf 2. https://www.gktoday.in/academy/article/indias-rock-formation-archean-dharwar-cudappah-vindhyan-gondwana-and-tertiary-rocks/ 3. https://www.pmfias.com/indian-rock-system-archaean-purana-dravidian-aryan-rock-system/ 4. https://digital.library.adelaide.edu.au/dspace/bitstream/2440/103376/2/02wholeGeoHon.pdf 5. https://theodora.com/encyclopedia/c/cambrian_system.html 6. https://www.britannica.com/science/Permian-Period	

	7. https://massextinction.princeton.edu/deccan-volcanism/01-deccan-volcanism-adventure-science
Course Outcomes	On completion of Course, the students should be able to 1. Explain about the fundamental principles of Stratigraphy and physiographic divisions of India. 2. Identify rocks and fossils of the Proterozoic period. 3. Evaluate the sub divisions of the Paleozoic period. 4. Demonstrate the Mesozoic systems. *5.* Outline about age of Deccan traps, Gondwana and Tertiary group of series.

18GEOU0205 - Stratigraphy												
CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	1	2	3	2	1	2	3	2	3	3	3
CO2	3	2	1	3	1	1	2	3	1	2	3	2
CO3	3	1	1	3	1	2	2	3	1	2	2	2
CO4	3	1	1	3	1	1	2	3	1	2	3	2
CO5	3	1	1	3	2	2	1	3	1	2	2	2

Course Code & Title	**18GEOU0206** **Structural Geology Practical**		
Class	**B. Sc Geology**	**Semester**	**II**
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To Complete the Structural Geology Maps • To Compute the Strike and Dip of the Beds • To Write Geological history of the maps		

Unit	**Contents**
	a) Study of Topographical maps b) Contour Maps and their interpretation c) Exercises to find out trend of the outcrop of horizontal, vertical, inclined beds with respect to topography d) Reading of solid, conformable maps e) Deciphering dip and strike of outcrops f) Completion of map when three points over a bedding plane are given g) Determination of vertical thickness of formations. h) Reading of solid fold and fault maps –Determination of throw of faults – Construction of vertical sections i) Reading of unconformable solid maps – Construction of sections j) Reading of solid maps of areas with more than one structure and intrusion – Writing of geological history. k) Solving of dip and strike problems by trigonometrical method l) Determination of true dip & apparent dip and thickness by calculation and graphical method.
Course Outcomes	On completion of Course, the students should be able to 1. Analyze the contour maps and assess the strike and dip of the maps 2. Compute the thickness of the outcrops 3. Prepare the stratigraphy sections for the maps 4. Identify the true and apparent dip through trigonometrical, calculation and graphical method

18GEOU0206 - Structural Geology Practical												
CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	3	1	3	2	2	2	3	1	3	2	2
CO2	3	3	1	3	3	1	2	3	2	3	1	2
CO3	3	3	1	3	1	2	3	3	1	3	2	2
CO4	3	3	1	3	1	2	2	3	1	3	1	2

Course Code & Title	**18GEOU0307** **Paleontology**		
Class	**B. Sc. Geology**	**Semester**	**III**
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To Explore the fundamentals of Paleontology • To Know about the Mollusca • To Describe about the Brachiopoda and plant fossils • To Illustrate about the Echinodermata. • To Describe the vertebrate Fossils.		

Unit	Content	No. of Hours
I	**Detailed account on Geological time scale. Fossils and fossilization: Definition -** Modes of preservation of fossils – Physico- chemical conditions for fossilization – Types of fossils – Significance of fossils. **Collection, preparation and nomenclature of fossils**: Collection of fossils – preparation of fossils – nomenclature of fossils. Types of fossils – **Significance of fossils**–Study of chrono stratigraphy – Bio stratigraphy - Index fossils and zone fossils - *study of paleogeography* – study of paleo climate, paleo ecology, organic evolution – use of fossils. ***Paleobotany:*** Modes of preservation of plant fossils. Outline of classification of organisms. Short account of Gondwana flora; Tertiary flora; Glossopteris, Gangamopteris, Calamites, Lepidodendron, Sigillaria and Ptilophyllum. ***Outline of uses of microfossils***.	12 Lectures
II	Mollusca: ***Lamellibranchia*****:** Morphology, classification, geological distribution and important fossils – ***Gastropoda:***Morphology, classification, geological distribution and important fossils – ***Cephalopoda***: Morphology, classification, geological distribution and important fossils.	12 Lectures
III	***Brachiopoda:*** Morphology, classification, geological distribution and important fossils - **Coelenterata:** Morphology, classification, geological distribution and important fossils - **Hemichordata:** Class **Graptozoa**: Morphology, classification, geological distribution and important fossils. **Devonian System. The carboniferous system:** Carboniferous of Spiti – Carboniferous of Kashmir**. The Permian System:** Kashmir – Salt range**.**	12 Lectures
	Echinodermata: Morphology, classification, geological distribution and important fossils - ***Trilobites*****:** Morphology, classification, geological distribution and important fossils - **Foraminifera:** Morphology,	12 Lectures

IV	classification, geological distribution and important fossils - **Porifera** – Sponges: Morphology, classification, geological distribution and important fossils	
V	**Vertebrate Paleontology**: **Pisces**: General features - **Amphibians:** Origin, general features - **Reptiles**: Origin, general features, Dinosaurs and their classification and extinction – Archaeopteryx - **Aves:** Origin, general features - **Mammals**: Origin, general features of: Equus, Elephas and Homo.	12 Lectures
References	**Text Books:** 1. Jain, M. L. & P. C. Anantharaman., An Introduction to Paleontology. Vishal Publications. Delhi, 2013 2. Henry Woods, Paleontology Invertebrate, TheUniversity Press, 2005 **Reference Books:** 1. Moore, R.C, Lalicker, C.G & Fisher, A.G Invertebrate fossils. (1st Indian edition), CBS Publishers &Distributors,New Delhi, 1997 2. Black, R.M.,, Elements of Paleontology, OxfordUniversity Press, UK, 1972. 3. Clarkson, E.N.K. Invertebrate Paleontology andEvolution, Wiley, New Delhi, 2005. 4. Shrock & Twenhofel, Principles of invertebrate paleontology, 2nd edition, New Delhi, 2005 5. Easton, W. H., Invertebrate Paleontology. Harper & Brothers. New York, 1960 6. Underlined Titles are available at Swayam portal. **Web Resources:** 1. *http://www.biologydiscussion.com/articles/geological-time-scale-meaning-divisions-and-events/22622* 2. *http://www.uno.edu/cos/earth-environmental-sciences/ees-docs/ClassResources/Lab6_Fossilization.pdf* 3. *https://sites.google.com/site/paleoplant/home/what-is-paleobotany* 4. *http://www.ucmp.berkeley.edu/mollusca/mollusca/gastropoda/gastropodafr.html* 5. *https://theodora.com/encyclopedia/l/lamellibranchia.html* 6. *http://www.ordovicianatlas.org/atlas/brachiopoda/brachiopod-general-morphology/* 7. *http://www.ucmp.berkeley.edu/echinodermata/echinomm.html* 8. *http://www.ucmp.berkeley.edu/foram/forammm.html*	
Course Outcomes	On completion of Course, the students should be able to 1. Explain about the modes of preservation of fossils 2. Evaluate the morphology of the Mollusca fossils 3. Demonstrate the morphology of the Brachopida, Coelenterata and Graptozoa. 4. Explain the morphology of Echinodermata, Trilobites, Foraminifers and Porifera 5. Outline about the origin of vertebrates.	

18GEOU0307 - Paleontology												
CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	2	1	3	2	1	2	3	1	1	3	2
CO2	3	3	1	2	2	1	1	3	2	1	3	2
CO3	3	2	1	3	1	1	1	3	1	2	3	1
CO4	3	2	1	3	1	1	1	3	1	2	3	1
CO5	3	2	1	3	1	1	1	3	1	2	3	1

Course Code & Title	**18GEOU0308** **Paleontology Practical**		
Class	**B. Sc Geology**	**Semester**	**III**
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To Know about various types of fossils • To Examine the morphological characteristics of the fossils • To Describe the age with respect to the fossils		

Unit	**Contents**
	Identification and description of the following fossils: a) **Lamellibranchs:** Arca, Meretrix, Pecten, Cardita, Lima, Allectronia, Inoceramus, Gryphaea, Exogyra, Radiolites, Ostrea, Unio, Trigonia. b) **Gastropods**: Turritella, Turbo, Cerithium, Trochus, Physa, Murex, Voluta, Helix, Euomphalus, Cyprea. c) **Cephalopods**: Nautilus, Orthoceras, Ceratite, Goniatite, Belemnites, Baculites, and Perisphinctes. d) **Echinodermata**: Cidaris, Holaster, Hemiaster, Stigmatophygus, Apiocrinus. e) **Trilobites**: Paradoxides, Olenus, Olenellus, Phacops, Calymene. f) **Corals**: Calceola, Zaphrentis, Lithostrotion, Omphyma, Thecosmelia. g) **Brachiopoda**: Terebratula, Spirifer, Productus, Monograptus, Tetragraptus, Diplograptus. h) **Plant fossils**: Ptilophyllum, Glossopteris, Lepidodendron and Petrified wood.
Course Outcomes	On completion of Course, the students should be able to 1. *Explain about the morphology of Lamellibranchs and Gastropods.* 2. *Evaluate the morphology of the Cephalopods and Echinodermata* 3. *Demonstrate the morphology of the Trilobites, Corals, Brachiopoda.* 4. *Outline about the Plant fossils.*

18GEOU0308 - Paleontology Practical												
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	1	2	3	1
CO2	3	2	1	3	1	1	1	3	1	2	3	1
CO3	3	2	1	3	1	1	1	3	1	2	3	1
CO4	3	2	1	3	1	1	1	3	1	2	3	1

Course Code & Title	**18GEOU0410** **Crystallography**		
Class	**B. Sc Geology**	**Semester**	**IV**
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To Know about the Internal and External structures of crystals and its characteristics • To demonstrate the Isometric and Tetragonal system • To Classify the Hexagonal system and Rhombohedral divisions. • To learn about the Orthorhombic, Monoclinic and Triclinic crystal forms. • To Explore the characters of twinning in crystals		

Unit	Content	No. of Hours
I	***Crystallography:*** Definition of a crystal - Molecular structure in general - Crystalline and amorphous - External form - Variation of form and surface - Constancy of the Interfacial angles in the same species - Diversity of Form or habit - Diversity of Size - Symmetry in General - Planes of symmetry - Axes of symmetry - Centre of symmetry - Relation of Geometrical to Crystallographic symmetry - Pseudo symmetry - Crystallographic axes - *Systems of crystallization*.	12 Lectures
II	**Isometric system**: Normal class - Pyritohedral class - Tetrahedral class - Plagiohedral class - Tetratohedral class. **Tetragonal system**: Normal class - Hemimorphic class - Tripyramidal class - Pyramidal - Hemimorphic class - Sphenoidal class - Trapezohedral class - Tetratohedral class.	12 Lectures
III	**Hexagonal system**: Normal class - Hemimorphic class - Tripyramidal class - Pyramidal - Hemimorphic class - Trapezohedral class - **Rhombohedral division**: Trigonal class - Rhombohedral class - Rhombohedral hemimorphic class - Tri-Rhombohedral class - Trapezohedral class.	12 Lectures
IV	**Orthorhombic system**: Normal class - Hemimorphic class - Sphenoidal class. **Monoclinic system**: Normal class - Hemimorphic class - Clinohedral class -**Triclinic system**: Normal class - Asymmetric class.	12 Lectures
V	**Compound or Twin crystals**: Definition - Distinction between Twinning and Parallel grouping - Twinning Axis - Twinning Plane - Composition plane - Contact and Penetration twins - Paragenic and Metagenic twins - Repeated twinning, polysynthetic and symmetrical - Secondary twinning - **Twinning**: Isometric system - Tetragonal system - Hexagonal system - Orthorhombic system - Monoclinic system - Triclinic system.	12 Lectures

References	**Text Books:** **1.** Ford, W.E, Dana's Textbook of Mineralogy. Wiley. New Delhi. (Reprint), 1988. 2. Parbin Singh, B. A Textbook of Engineering and General Geology. S. K. Kataria & Sons. Delhi, 2005. **Reference Books:** 1. Perkins, D. & K. R. Henke, Minerals in Thin Section, Prentice Hall, New Delhi, 2003. 2. Kerr, P. F., Optical Mineralogy, 4th ed. McGraw Hill New York, 1977 3. Berry Mason, L.G, Mineralogy, W.H. Freeman &Co. - 1985. 4. Deer, W. A., Howie, R. A & Zussman An Introduction to Rock forming Minerals, Third Edition, ELBS, Ed.2013. 5. Ravell Phillips, W. M. & Dana.T. Griffen, Optical Mineralogy-The Non-Opaque Minerals, CBS publishers & Distributors, 2004. 6. *Underlined Titles are available at Swayam portal.* **Web Resources:** 1. https://www.britannica.com/science/isometric-system 2. http://www.mineralogy4kids.org/all-about-crystals/crystal-systems/tetragonal-system 3. https://uwaterloo.ca/earth-sciences-museum/resources/crystal-shapes/hexagonal-crystal-system 4. https://www.britannica.com/science/orthorhombic-system 5. https://uwaterloo.ca/earth-sciences-museum/resources/crystal-shapes/monoclinic-crystal-system 6. http://www.chem.wisc.edu/~danny/interactive/triclinic/
Course Outcomes	On completion of Course, the students should be able to 1. Explain about the basics of crystallography, various crystal forms, Crystallographic Axis and symmetry 2. Demonstrate about Isometric and tetragonal crystal forms. 3. Identify and describe the Hexagonal, rhombohedral and mineral forms 4. Identify the Orthorhombic, Monoclinic and triclinic crystal forms. 5. Describe about Twinning crystals.

18GEOU0410 - Crystallography												
CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	2	2	3	3	2	2	3	1	2	1	2
CO2	3	2	1	3	2	2	1	3	1	1	1	1
CO3	3	1	1	3	2	2	1	3	1	1	1	1
CO4	3	1	1	3	2	2	1	3	1	2	1	1
CO5	3	1	1	3	3	2	2	3	1	2	1	2

Course Code & Title	**18GEOU0411** **Mineralogy**		
Class	**B. Sc Geology**	**Semester**	**IV**
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To learn about the physical and chemical properties of minerals • To Explain the Quartz and Feldspar Groups of Minerals and its verities • To classify the Feldspathoid and Pyroxene Group of essential minerals. • To Categorize minerals in Amphibole, Olivine, Mica, Garnet, and Zeolite groups of minerals, and accessory menials • To know about the Microscope parts and Optical characteristics of Minerals.		

Unit	Content	No. of Hours
I	**Mineralogy**: An Introduction – Properties of minerals – ***Physical properties of minerals*****: Based on cohesion**: Form, structure, Cleavage, Hardness, Fracture, Tenacity, Specific gravity. Prosperities Based on Light: Colour, Streak, Lusture, Transparency, fluorescence, Phosphorescence, **Properties based on heat, electricity, and Magnetism:** heat, electricity, magnetism, **properties based on senses:** Taste, Odour, feel. **Chemical properties of minerals:** Isomorphism, Polymorphism,	12 Lectures
II	**Quartz Group:** Description, General Characteristics, Crystalline Verities, Cryptocrystalline Verities, Amorphous Verities. **Feldspar Group:** Crystal System Details, Introduction, **Alkali Feldspar**: Orthoclase, Varieties, Celsian, Microcline, Perthite. **Plagioclase Feldspar: Plagioclase Series -** Albite, Intermediate, Anorthite. Phenomena of Solid Solution. Solid Solution, Solid Solution in Plagioclase Feldspars	12 Lectures
III	**Feldspathoid Group:** Introduction, Chemistry, Leucite, Nepheline, Cancrinite, Sodalite, Hauynite, Noselite, Lazurite. **Pyroxene Group:** General Characteristics, Orthopyroxene, Clinopyroxene, Clinoenstatites, Pigeonite, Diopside-Hedenbergite, Augite, Wollastonite, Agerite, Jadeite, Spodumene, Rhodonite.	12 Lectures
IV	**Amphibole Group:** General Characteristics, Anthophyllite, Cummingtonite, Tremolite- Actinolite, Hornblende, Barkevekite, Glaucophane – Ribeckite, Arfvedsonite. General description and Mineral characteristics of **Olivine group Minerals**: **Mica group Minerals**: **Garnet Group Minerals: Zeolite Group Minerals. Salient Features of Accessory Minerals: Epidote, Scapolite, Beryl, Apatite, Fluorite,**	12 Lectures

	Kyanite, Sillimanite, Anadalusite, Topaz, Tourmaline, Cordierite, Calcite, Dolomite, Staurolite, Talc, Kaoline, Serpentine, Steatite, Zirocon, Sphene, Rutile, Magnetite, Ilmenite.	
V	**Optical Mineralogy: Elementary concept of Light. Polarization and Nicol Prism. Petrologic Microscope. Behavior of the light through the Microscope. Study of Minerals under Petrological Microscope. Simple Optical Accessories.**	12 Lectures
References	**Text Books:** 1. Berry Mason, L.G, Mineralogy, W.H. Freeman &Co. 1985. 2. Gribble, C. D., Rutley's Elements of Mineralogy. CBS,New Delhi, 1988. 3. ParbinSingh, B., A Textbook of Engineering and General Geology, S. K. Kataria & Sons. Delhi, 2005. **Reference Books:** 1. Perkins, Dexter, Mineralogy (3rd Edition) Prentice Hall, 2010. 2. Dana, E.S, A Text Book of Mineralogy, Wiley Eastern, 2006. 3. Kerr B.F, Optical Mineralogy. McGraw Hill, 5thEdition, New York, 1995. 4. Deer, W. A., Howie, R. A & Zussman- An Introductionto Rockforming Minerals, Third Edition, ELBS, Ed.2013. 5. Revelli Phillips, W.M. &Dana.T. Griffen, Optical Mineralogy-The Non- Opaque Minerals, CBS publishers &Distributors, 2004. 6. Underlined Titles are available at Swayam portal. **Web Resources:** 1. https://www.tulane.edu/~sanelson/eens211/silicate_structures08.htm 2. https://www.britannica.com/science/mineral-chemical-compound/Nesosilicates 3. http://bsrithai.geol.science.cmu.ac.th/pdf/205234/Sorosilicate.pdf 4. http://bsrithai.geol.science.cmu.ac.th/pdf/205234/Cyclosilicate.pdf 5. https://www.tulane.edu/~sanelson/eens211/inosilicates.pdf 6. http://www.geo.umass.edu/courses/geo311/phyllosilicates.pdf 7. http://www.geo.umass.edu/courses/geo311/lecture%2012%20Tectosilicates.pdf. 8. http://www.geo.umass.edu/courses/geo311/pyroxenes.pdf	
Course Outcomes	On completion of Course, the students should be able to 1. Identify the physical and chemical properties of the minerals 2. Explain about verities of minerals in Quartz and Feldspar Groups 3. Demonstrate minerals in Feldspathoid and Pyroxene Groups. 4. Outline the minerals in Amphibole, Olivine, Mica, Garnet, Zeolite groups of minerals, and accessory minerals. **5.** Identify the Optical Characteristics of various Minerals.	

18GEOU0411 - Mineralogy												
CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	2	1	3	3	2	3	3	2	3	2	2
CO2	3	1	1	3	2	1	1	3	1	2	1	2
CO3	3	1	1	3	2	1	1	3	1	2	1	2
CO4	3	1	1	3	2	1	1	3	1	2	1	2
CO5	3	1	1	3	2	1	1	3	1	2	1	2

Course Code & Title	**18GEOU0412** **Crystallography Practical**		
Class	**B. Sc. Geology**	**Semester**	**IV**
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To do Exercises on Crystal Models • To identify the Crystal Axis and Symmetries • To identify the Twinning Crystals.		

Unit	Contents
	Description of forms present and determination of Miller indices of the following crystal models: I. **Isometric System:** Normal Class – Galena, Fluorite, Magnetite, Garnet, and Leucite, Copper- Pyritohedral class – Pyrite, Tetrahedral Class – Tetrahedrite. II. **Tetragonal System**: Normal Class – Zircon, Vesuvianite, Cassiterite, and Rutile. Tripyramidal – Scheelite, Meionite Sphenidal Class – Chalcopyrite. III. **Hexagonal System**: Normal Class – Beryl, Tripyramidal – Apatite, Hemimorphic – Zincite, Rhombohedral Normal – Calcite, Trapezohedral Class – Quartz. IV. **Orthorhombic System**: Normal – Barite, Sulphur, Stibnite, Topaz, Staurolite, and Aragonite. Hemimorphic – Calymene, Sphenoidal Class – Epsomite. V. **Monoclinic System**: Normal – Gypsum, Pyroxenes and Amphiboles. VI. **Triclinic System**: Normal – Axinite, Albite, and Rhodonite. VII. **Twin Crystals**: Contact and Penetration twins of Fluorite, Iron Cross Twin of Pyrite, Knee type twin of Cassiterite, Polysynthetic twin of Aragonite, Cyclic twin of Cerussite, Swallow Tail of Gypsum, Twins of Carlsbad, Baveno, Manebach, Albite law of Albite
Course Outcomes	On completion of Course, the students should be able to 1. Identify the various crystal Systems and Symmetry through crystal models 2. Assess the miller Indices of the crystal models 3. Identify of Twining crystals.

18GEOU0412 - Crystallography Practical												
CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	3	1	3	2	1	3	3	2	3	1	3
CO2	3	3	1	3	2	1	2	3	1	2	1	2
CO3	3	3	1	3	1	1	3	3	1	2	1	2
CO4	3	2	1	3	1	1	2	3	2	2	1	2

Course Code & Title	**18GEOU0413** **Mineralogy Practical**		
Class	**B. Sc Geology**	**Semester**	**IV**
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To Study the megascopic properties rock forming minerals • To Understand the Origin and Occurrences of the minerals • To Examine the optical properties of rock forming minerals		

Unit	Contents
	Megascopic identification and description of the following: a) **Quartz group**: Quartz, chalcedony, opal, agate, flint, jasper, amethyst, rose quartz b) **Feldspar group**: Orthoclase, microcline, albite, oligoclase, labradorite c) **Feldspathoid group**: Adularia, sanidine, nepheline, sodalite, lapislazuli d) **Pyroxene group:** Enstatite, bronzite, hypersthene, augite e) **Amphibole group**: Hornblende, Actinolite, Tremolite f) **Olivine group:** Olivine, serpentine g) **Mica group**: Muscovite, biotite, phlogopite, lepidolite, vermiculite h) **Other minerals**: Chlorite, epidote, garnet, apophyllite, stilbite, heulandite, talc, steatite, beryl, kaolin, cordierite, apatite, andalusite, staurolite, sillimanite, kyanite, tourmaline, topaz, calcite, dolomite and fluorspar. **Optical Mineralogy:** i) **Microscopic identification and description of the following**: quartz, orthoclase, albite, oligoclase, andesine, labradorite, anorthite, nepheline, leucite, sodalite, hypersthene, augite, diopside, aegirine, hornblende, tremolite, actinolite, glaucophane, riebeckite, muscovite, biotite, phlogopite, olivine, serpentine, chlorite, epidote, garnet, apatite, zircon, sphene, magnetite, tourmaline, calcite, dolomite, andalusite, staurolite, sillimanite and cordierite.
Course Outcomes	On completion of Course, the students should be able to 1. Identify the megascopic properties of Quartz and Feldspar group of minerals 2. Outline the megascopic properties of Feldspathoid and pyroxene group of minerals 3. Demonstrate the megascopic properties of Amphibole group of minerals *4.* Identify, Discriminate and describe the megascopic properties of olivine and Mica group of Minerals. *5.* Describe about Microscopic identification of minerals.

18GEOU0413 - Mineralogy Practical												
CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	2	1	3	1	2	3	3	1	3	1	3
CO2	3	2	1	3	1	1	3	3	1	2	1	2
CO3	3	2	1	3	1	2	2	3	1	3	1	2
CO4	3	2	1	3	1	2	3	3	1	2	1	3
CO5	3	2	1	3	2	1	3	3	2	3	1	2

Course Code & Title	**18GEOU0515** **Igneous and Metamorphic Petrology**		
Class	**B. Sc Geology**	**Semester**	**V**
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • *To Describe the Composition of Magma* • *To Classify the various types of Igneous rocks* • *To Describe the origin of Igneous and Metamorphic rocks* • *To Discriminate the Igneous and Metamorphic rocks* • *To Categorize the various types of Metamorphic rocks.*		

Unit	Content	No. of Hours
I	**Igneous Rocks:** Magma – Volcanic rocks – Plutonic rocks – Hypabyssal rocks. **Composition**: Chemical composition – Mineralogical composition. **Textures of igneous rocks**: Factors explaining textures: Degree of crystallization – Granularity – Fabric. **Types of Textures**: Equigranular texture – Inequigranular texture – Porphyritic texture – Poiklitic texture – Directive texture – Inter growth texture -Intergranular texture. **Structures of Igneous Rocks**: Definition – Types: Flow – Pillow – Ropy and Block – Spherulitc and orbicular- Vesicular structure – Miscellaneous structure.	13 Lectures
II	**Forms of Igneous Rocks**: Concordant bodies – Discordant Bodies – Igneous extrusions. ***Classification of Igneous Rocks***: USGS classification - Chemical Classification – Mineralogical Classification – Textural Classification -Tabular Classification - **Formation of Igneous Rocks:** The Source Magma - The Process Crystallization - **Crystallization of a Unicomponent Magma**(Basics)**:** Augite System - Grain of Igneous Rocks - Formation of Glass -**Crystallization of Binary Magma**(Concept): Diopside - Anorthite System - Albite –Anorthite system – Eutectics – Mixed crystals.	13 Lectures
III	**Bowen's reaction series** - **Mechanism and processes of magmatic differentiation**. Assimilation. Distinguished Properties of Petrographic Characteristics of **Granite, Granodiorite and Diorite, Syenite, Nepheline - Syenite and related alkaline rocks - Gabbro, Anorthosite and peridotite – Dolerite and Lamprophyre – Rhyolite and Dacite – Trachyte and Phonolite – Andesite and Basalt.**	13 Lectures
IV	**Metamorphic Petrology: Description, Factors (Agents) of Metamorphism:** Temperature, Pressure, Chemical Environment. ***Kinds of Metamorphism***: Thermal Metamorphism, Dynamic Metamorphism, Dynamothermal Metamorphism. **Metasomatism, Metamorphic Textures:** Crystalloblastic Textures, Palimpsest (Relict) Textures.	13 Lectures

	Metamorphic Structures: Cataclastic Structure, Schistose Structure, Gneissose Structure, Maculose Structure, Augen Structure, Granulose Structure.	
V	**Classification of Metamorphic Rocks**: Foliated Rocks, Non-Foliated Rocks. **Important Metamorphic Rocks:** Slate, Schist, *Gneiss*, Quartzite, Marble, Phyllite, Hornfels. Migmatite, Eclogites.	13 Lectures
References	**Text Books:** 1. Tyrell, G. W., Principles of Petrology. B.I.Publications. New Delhi, 1958. 2. Parbin Singh, B., A Textbook of Engineering andGeneral Geology, S. K. Kataria & Sons. Delhi, 2005. **Reference Books:** 1. Best, M. G., Igneous Petrology. Wiley. New Delhi, 2005. 2. Best, M. G., Igneous and Metamorphic Petrology. Wiley. New Delhi, 2003. 3. Turner, F.J., Metamorphic Petrology. McGraw Hill. New York, 1968. 4. H. William, F.J. Turner and C.M. Gilbert Petrography, Freeman and Company, 1954. 5. Turner, F.J., and Verhoogen, J., Igneous and Metamorphic petrology, C.B.S. Publishers and Distributors, Delhi, 2004. *6. Underlined Titles are available at Swayam portal.* **Web Resources:** *1. https://flexiblelearning.auckland.ac.nz/rocks_minerals/rocks/* *2. http://www.indiana.edu/~geol105/images/gaia_chapter_5/igneous_rock_textures.htm* *3. https://www.tulane.edu/~sanelson/eens212/intro&textures.html* *4. https://www.eartheclipse.com/geology/formation-types-and-examples-of-igneous-rocks.html* *5. http://pages.geo.wvu.edu/~lang/Geol285/Pet5PhaseD-outline.pdf* *6. https://opentextbc.ca/geology/chapter/3-3-crystallization-of-magma/* *7. https://www.tulane.edu/~sanelson/eens212/typesmetamorph.html* *8. http://csmgeo.csm.jmu.edu/geollab/Fichter/MetaRx/Textclass.html* *9. http://www.appstate.edu/~abbottrn/rck-id/mtmchrt.html*	
Course Outcomes	On completion of Course, the students should be able to 1. Discuss about the Igneous rocks, their texture and structures 2. Explain about forms and classification of igneous rocks 3. Demonstrate about the Crystallization of Uni- component, Binary and Ternary magma as well as the petrographic properties of various igneous rocks 4. Explain about the Metamorphic rocks, their texture and structure *5.* Evaluate the types of metamorphic rocks.	

18GEOU0515 - Igneous and Metamorphic Petrology												
CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	1	2	3	2	2	3	3	1	3	3	3
CO2	3	1	1	3	1	1	2	3	1	2	2	2
CO3	3	1	1	3	2	1	2	3	1	3	1	1
CO4	3	1	2	3	1	1	3	3	1	2	1	2
CO5	3	1	2	3	1	1	3	3	1	2	2	1

Course Code & Title	**18GEOU0516** **Sedimentary petrology and Marine Geology**		
Class	**B. Sc Geology**	**Semester**	**V**
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To Understand the origin and nature of Sedimentary rocks • To Recognize the forms, structures and textures of the Sedimentary rocks, • To Classify the petrogenesis of Sedimentary rocks • To understand the marine process. • To Evaluate the morphological features of marine landforms		

Unit	Content	No. of Hours
I	***Sedimentary Petrology*:** Description and formation of sedimentary rocks: Clastic (Mechanically Formed) Rocks, Chemically Formed Rocks, Organically formed rocks. **Environment of Formation:** Facies - Continental facies – Transitional facies – Marine facies. **Mineralogical formation**: Nature of Gathering ground – Duration of Transport – Mixing up of sediments – Allogenic and Authigenic minerals.	13 Lectures
II	**Textures of Sedimentary rocks:** Origin of Grains – Size of grains – shape of grains – packing of grains – fabric of grains – Crystallization trend. **Structures of sedimentary rocks**: Mechanical structure - chemical structure – organic structure.	13 Lectures
III	**Classification of sedimentary rocks**: **Clastic rocks:** Gravels – Sands – Silts clays – **Non- clastic rocks:** Chemically formed rocks – organic deposits – miscellaneous deposits.	13 Lectures
IV	**Descriptive petrography of following sedimentary rocks**: Breccia – Conglomerate – Sandstone – Shale – Limestone – Dolomite – Coal- Iron ores of sedimentary origin – Gypsum – Rock salt – Flint and chert – Tillite.	13 Lectures
V	**Marine Geology:** Ocean morphology– Continental shelf – Continental slope – Submarine canyons – Mid- oceanic ridges - The sea waves and currents – Oscillatory waves – Translatory waves – Littoral currents – Rip currents - **Physical and chemical properties of Ocean water** - Factors affecting surface flow of currents – Coriolis effect, Ekman's spiral. Tides and their types. **Tsunamis**: origin, significance and prediction. Ocean pollution. **Mineral deposits of ocean floor**.	13 Lectures
	Text Books: 1. Parbin Singh, B., A Textbook of Engineering and General Geology. S. K. Kataria & Sons. Delhi, 2005.	

References	2. Savindra Singh., Oceanography, Pravalika Publications, Allahabad, 2014. **Reference Books:** 1. Pettijohn, F.J., Sedimentary Rocks, Harper & Row, New York, 3rdEdision, 1975. 2. Sengupta, S., Introduction to Sedimentology, CBS Publishers and Distributors, 2011. 3. E. G. Ehlers, H. Blatt, Petrology Igneous Sedimentary and Metamorphic, 3rd Edition, 2005. 4. U.S. Army Corps of Engineers, Coastal Geology, University press of the Pacific Honolulu, Hawaii, 1995. **5.** *Underlined Titles are available at Swayam portal* **Web Resources:** 1. https://www.eartheclipse.com/geology/formation-types-and-examples-of-sedimentary-rocks.html 2. http://www.geologyin.com/2014/12/sedimentary-textures-and-classification.html 3. http://www.rocksandminerals4u.com/sedimentary_rock.html 4. http://csmgeo.csm.jmu.edu/geollab/fichter/SedRx/sedclass.html 5. http://www.scseagrant.org/pdf_files/sos_chap_2.pdf 6. http://www.waterencyclopedia.com/Mi-Oc/Mineral-Resources-from-the-Ocean.html
Course Outcomes	On completion of Course, the students should be able to 1. Explain about the sedimentary rocks and their genesis of formation 2. Outline the various structure and texture of sedimentary rocks 3. Discuss the Classification of Sedimentary rocks 4. Evaluate the petrographic properties of Sedimentary rocks *5.* Explain about the sea waves, currents, physio chemical properties of ocean and the marine mineral deposits.

18GEOU0516 - Sedimentary petrology and Marine Geology												
CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	1	2	3	2	2	3	3	2	3	2	3
CO2	3	1	2	3	1	1	2	3	1	3	2	2
CO3	3	1	1	3	1	1	3	3	1	3	2	2
CO4	3	1	2	3	1	1	2	3	1	3	2	3
CO5	3	2	1	3	3	1	2	3	1	3	3	3

Course Code & Title	**18GEOU0517** **Igneous petrology (Practical)**		
Class	**B. Sc Geology**	**Semester**	**V**
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To Do exercises on the Igneous rocks hand specimens • To Evaluate the optical properties of important Igneous rocks.		

Unit	Contents
	a) **Acid igneous rocks:** Granites: Graphic granite, aplite, pegmatite, tourmaline granite, schorl rock, pyroxene granite, hornblende granite, mica granite, pink granite, porphyritic granite, grano diorite. b) **Intermediate Igneous rocks:** Syenites: Quartz syenite, corundum syenite, nepheline syenite, perthitic syenite, pyroxene syenite, hornblende syenite, mica syenite, porphyritic syenite, diorite. c) **Basic Igneous rocks:** Gabbro, norite, dolerite. d) **Ultra-basic igneous rocks:** Anorthosite. e) **Alkaline igneous rocks:** Lamphrophyre, carbonatite, kimberlite. f) **Volcanic igneous rocks:** Basalts: Vesicular, Amygdaloidal, vitrophyric basalt, pitchstone, scoria, pumice, obsidian, rhyolite, rhyodacite, trachyte**.** g) ***Microscopic identification and description of the following***: Mica granite, hornblende granite, tourmaline granite, schorl rock, aplite, graphic granite, quartz syenite, mica syenite, hornblende syenite, nepheline syenite, quartz diorite, hornblende diorite, olivine gabbro, hypersthene gabbro, troctolite, dunite, peridotite granite porphyry; syenite porphyry, diorite porphyry, quartz porphyry, dolerite, minette, anorthosite, rhyolite, trachyte, andesite, basalt, leucite, phonolite, nosean, and volcanic breccia.
Course Outcomes	On completion of Course, the students should be able to 1. Identify and discuss the megascopic properties of acid igneous rocks. 2. Identify and discuss the megascopic properties of Intermediate rocks *3.* Identify and discuss the megascopic properties of basic, ultrabasic and alkaline rocks. *4.* Identify and discuss the microscopic properties of igneous rocks.

18GEOU0517 - Igneous petrology (Practical)												
CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	3	1	3	1	2	1	3	1	3	1	3
CO2	3	3	1	3	1	2	1	3	1	3	1	3
CO3	3	3	1	3	1	2	1	3	1	3	1	3
CO4	3	3	1	3	2	2	2	3	1	2	1	3

Course Code & Title	**18GEOU0518** **Metamorphic and Sedimentary Petrology (Practical)**		
Class	**B. Sc Geology**	**Semester**	**V**
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To Do exercises on the Sedimentary and Metamorphic rocks hand specimens • To Evaluate the optical properties of important Sedimentary and Metamorphic rocks		

Unit	**Contents**
	Sedimentary Rocks: I. ***Megascopic identification and description of the following***: conglomerate, breccia, laterite, sandstone, arkose, greywacke, grit, shales, limestones, chert, flint, peat, bituminous coal, anthracite, lignite, chalk. II. ***Microscopic identification and description of the following***: sandstone, arkose, breccias; conglomerate shale, greywackes, limestone, flint and chert. **Metamorphic Rocks:** III. ***Megascopic identification and description of the following*:** slate, phyllite; schists: mica, kyanite, amphibole, and talc; gneisses: banded, argentiferous, migmatite varieties; amphibolite; eclogite; granulites: charnockite types; khondalite; gondite; grodurite; leptynite, marble, quartzite, skarn, hornfels. **IV.** ***Microscopic identification and description of the following*:** slate, phyllite, schists, mica, kyanite, amphibole, and talc; gneisses: banded, garnetiferous, migmatite varieties; amphibolite; eclogite; granulite: charnockite; khondalite; gondite; grodurite; leptynite; marble, quartzite, skarn,hornfels.
Course Outcomes	On completion of Course, the students should be able to 1. Identify and discuss the megascopic properties of Sedimentary rocks. 2. Identify and discuss the microscopic properties of Sedimentary rocks 3. Identify and discuss the megascopic properties of Metamorphic rocks. *4.* Identify and discuss the microscopic properties of Metamorphic rocks

18GEOU0518 - Metamorphic and Sedimentary Petrology (Practical)												
CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	3	1	3	1	2	3	3	1	3	1	3
CO2	3	3	1	3	2	2	3	3	1	3	1	3
CO3	3	3	1	3	1	2	3	3	1	3	1	3
CO4	3	3	1	3	2	2	3	3	1	3	1	3

Course Code & Title	**18GEOU05S1** **Geophysics in Groundwater Exploration**		
Class	**B. Sc Geology**	**Semester**	**V**
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To Illustrate the concept of Geophysical measurements • To Record and Interpret the Resistivity data for Groundwater Exploration		

Unit	Content	No. of Hours
I	***Geophysics Introduction:*** Resistivity, Electrical conduction through rocks, Range of Resistivity for Rocks and Minerals. **Measurement of Earth Resistivity:** Measurement of Earth Resistance, Potential Distribution, Electrode Configuration, Configuration factor, Wenner Array, Lee Partitioning Array, Schlumberger Array, Dipole Arrays, Gradient Array. **Survey Procedure:** Electrical Profiling, Resistivity Sounding (VES), Precautions. **Instruments used for Resistivity Measurements.**	11 Lectures
II	**Interpretation of Resistivity Sounding Data:** Qualitative Interpretation of Resistivity Sounding Data. Quantitative Techniques.	10 Lectures
References	**Text Books:** 1. Ramanuja Charry K.R (2012), Geophysical Techniques for Groundwater Exploration. Professional Book Publisher. 2. Ramachandra Rao, M.B., Outlines of Geophysical prospecting. Ebd, dhanbad, 1993. **Reference Books:** 1. Dobrin, M.B. &Savit, C.H., Introduction to Geophysical Prospecting. 4th ed. McGraw Hill. New Delhi, 1988. 2. Kearey, P., Brooks, M &Hill.I., An Introduction to Geophysical Exploration, 3rd ed. Blackwell science, 2002. **Web Resources:** 1. https://www.geophysik.uni-muenchen.de/~valerian/Oberwinkel_11/Anleitungen/Gravimetrie%20und%20Magnetik%20Grundlagen.pdf 2. ftp://ftp.ingv.it/pro/terrasol/materiale_consultazione/Lowrie_Fundamentals_of_geophysics_2007.pdf	

Course Outcomes	On completion of Course, the students should be able to 1. Describe about the basic principles of Geophysics and its application. 2. Explain the field procedure and interpretation of geophysical data for groundwater exploration.

18GEOU05S1 - Geophysics in Groundwater Exploration												
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	3	1
CO2	3	3	1	2	3	1	1	3	2	2	3	1

Course Code & Title	**18GEOU05S2** **Gemology**		
Class	**B. Sc Geology**	**Semester**	**V**
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To Examine the physical properties of gemstones • To Summarize the origin, classification of gemstones.		

Unit	Content	No. of Hours
I	***Introduction:*** Gemstones and their Influence**.** Terminology, The Nomenclature of Gemstones. **Origin and Structure of Gemstones:** Crystal Systems. **Properties of Gemstones:** Hardness, Cleavage and Fracture, Density and Specific Gravity, Weights Used in the Gem Trade. Optical Properties, Inclusion.	11 Lectures
II	**Deposits and Production of Gemstones:** Types of Deposits, Mining Methods. **Cutting and Polishing of Gems: Classification of Gemstones:** Scientific Classification, Commercial Classification. **Value of Gemstones: Description of Gemstones, Best Known Gemstones:** Diamond, Corundum, Beryl, Chrysoberyl, Spinel, Topaz, Garnet Group, Zircon, Tourmaline Group, Spodumene, Quartz, Opal Species, Jade, Peridot, Zoisite, Hematite, Pyrite, Feldspar group, Rhodochrosite, Rhodonite, Turquoise, Lapis Lazuli, Sodalite, Azurite, Malachite.	10 Lectures
References	**Text Books:** 1. Walter Schumann, Gemstones of the World, 5th Edition, 2015. 2. Peter G. Read, Gemmology, NAG Press, 3rd Edition, 2005. **Reference Books:** 1. Peter Read, Gemmology, 2nd Ed. Butter worth-Heinemanu Ltd. Lundu. (1991) 2. Peter Read. Gems 5th Ed. Buurerworth, London (2001) 3. Richard Laddicoat, Hand book of gem idendification- G.I.A. Santa Monica, (1987). **Web Resources:** 1. https://pubs.usgs.gov/gip/7000029/report.pdf 2. https://gem-a.com/images/Documents/JoG/2015/JoG-34-8-LR-3.pdf	
Course Outcomes	On completion of Course, the students should be able to 1. *Describe about the origin structure and properties of gemstones.* 2. *Explain about the various deposits of gemstones and their varieties*	

18GEOU05S2 - Gemology												
CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	3	2	2	3	1	1	3	2	2	3	1
CO2	3	1	1	2	2	1	1	3	1	2	3	1

Course Code & Title	**18GEOU0621** **Economic Geology**		
Class	**B. Sc Geology**	**Semester**	**VI**
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To Distinguish the metallic and non-metallic minerals • To Demonstrate the mineral resources of India • To Summarize the distribution & mode of occurrence of economic minerals • To Evaluate the industrial applications of economic minerals • To Describe National mineral policy, and their role in National economy.		

Unit	Content	No. of Hours
I	***Process of formation of Mineral Deposits*:** Magmatic concentration - Sublimation - Contact metasomatism - Bacteriogenic - Submarine exhalative and Volcanogenic - Evaporation - Residual and Mechanical concentration - Oxidation and Supergene enrichment - Metamorphism - ***Classification of mineral deposits***.	13 Lectures
II	**Mineral Resources in India- I:** Ore Mineralogy**,** Association, genesis, mode of occurrence, and Indian distribution of the following metallic ore deposits**– Aluminum: Iron: Chromium: Manganese: Molybdenum: Titanium**	13 Lectures
III	**Mineral Resources in India- II:** Ore mineralogy**,** Association, genesis, mode of occurrence, and Indian distribution of the following metallic ore deposits: **Copper: Gold: Silver**: **Uranium: Thorium: Beryllium: Zirconium, Lead & Zinc, Tin, Antimony, Bismuth**	13 Lectures
IV	**Mineral Resources in India- III:** Ore mineralogy, Association, genesis, mode of occurrence, and Indian distribution of the following ore deposits: **Abrasive Minerals: Industrial minerals: Refractory minerals: Ceramic minerals: Fertilizer minerals.**	13 Lectures
V	Ore mineralogy, Association, genesis, mode of occurrence, and Indian distribution of the following ore deposits: **Chemical minerals: Mineral pigments**. ***Mineral Economics*:** Concept of strategic, critical and essential minerals – Demand and supply - Mineral conservation and substitution. Outline of National Mineral Policy and Mineral Concession Rules.	13 Lectures
	Text Books: 1. Prasad, U., Economic Mineral Deposits. CBS Publishers, Delhi, 2003.	

References	2. Parbin Singh, B., A Textbook of Engineering and General Geology. S. K. Kataria & Sons. Delhi, 2005. **Reference Books:** 1. Bateman, A.M. & M. L. Jensen., Economic Mineral Deposits. 3rd ed. Wiley. New York, 1981. 2. Lindgren, Mineral deposits, McGraw Hill, 1933. 3. Krishnasamy, S., India's Mineral Resources. Oxford & IBH. Delhi, 1988. 4. Sharma, N. L & R. K. Sinha., Mineral Economics. Oxford & IBH. Delhi, 1985. 5. Gokhale & Rao, Ore Deposits of India, Thomson press, 2010. 6. Iyengar, N. K. N. Mineral wealth of Tamilnadu, Madras Govt., 1978. *7. Underlined Titles are available at Swayam portal.* **Web Resources:** 1. https://www.britannica.com/science/mineral-deposit/Formation-of-mineral-deposits 2. http://www.preservearticles.com/2012010519974/the-processes-of-formation-of-mineral-deposits-are-grouped-into-three-main-types.html 3. https://www.geologyforinvestors.com/classification-of-mineral-deposits/ *4.* https://iasmania.com/mineral-resources-india-iron-coal-aluminium-copper-lead-zinc/
Course Outcomes	On completion of Course, the students should be able to 1. Explain about the formation of mineral deposits 2. Demonstrate the distribution of mineral resources. 3. Discuss the Classification of the mineral deposits 4. Outline the various mineral resources of India *5.* Explain about the mineral policies of India.

18GEOU0621 -Economic Geology												
CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	2	1	2	2	1	1	3	2	2	3	1
CO2	3	1	1	2	2	1	1	3	2	2	3	1
CO3	3	1	1	2	2	1	1	3	2	2	3	1
CO4	3	1	1	3	2	1	1	3	1	2	2	1
CO5	3	1	1	1	2	1	1	3	1	2	2	1

Course Code & Title	**18GEOU0622** **Coal and Petroleum Geology**		
Class	**B. Sc Geology**	**Semester**	**VI**
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • *To gain knowledge about the coal, their formation, varieties and distribution.* • *To classify the various types of Coal and Petroliferous basins of India* • *To understand the different petroliferous basins of India and methods of exploration of petroleum.* • *To Evaluate the Well logging process* • *To Summarize Origin, Occurrences and Exploration of Coal and Petroleum*		

Unit	Content	No. of Hours
I	**Coal: Origin of coal:** Description - **Sedimentation of coal and coal bearing sequences:** Depositional model, traditional model, model peat analogues, facies correlation, facies map. **Structural effects of coal:** Syn depositional effect, post depositional effect.	12 Lectures
II	**Age and Occurrences of Coal:** Description, plate tectonics, stratigraphy. **Age and geographical distribution of coal:** Indian sub-continent. **Physical description of coal: Macroscopic description of coal: Microscopic description of coal.**	12 Lectures
III	**Mineral content of coal: Petrographic applications: Coalification (rank):** Coalification, causes of coalification. **Coal quality** and C**lassification of coal**.	12 Lectures
IV	**Petroleum Geology: Description of petroleum: *Origin and occurrences of petroleum*:** Surface occurrences, sub surface occurrences. Source rock, **reservoir rock and petroleum traps: Classification:** Fragmental reservoir rock –chemical reservoir rock – miscellaneous reservoir rock. Migration of petroleum. Onshore and offshore distribution of *Petroliferous basins in India.*	12 Lectures
V	***Well logging*:** Drillers logs, sample logs, electric logs, radiation logs, drilling time logs, core and mud analysis, capillary logs, temperature logs, sonic logs, nuclear magnetism logs**.**	12 Lectures
	Text Books: 1. Prasad, U., Economic Geology- Economic Mineral Deposits, Second Edition, CBS Publishers & Distributors Pvt Ltd, 2000.	

References	2. Levorsen A.I., Geology of Petroleum, CBS Publishers and Distributors, Delhi, Second Edition, 1985 **Reference Books:** 1. Selley, R.C., Elements of Petroleum Geology, Academic press, Delhi, 1998 2. Gokhale, K.V.G.K., & Rao, D.M., Ore Deposits of India *3. Underlined Titles are available in Swayam portal.* **Web Resources:** 1. http://www.coaleducation.org/ky_coal_facts/coal_resources/coal_origin.html 2. http://www.icr.org/article/origin-coal/ 3. http://www.geologydata.info/coal_02.html 4. http://kvbchemicalengg.com/pdf/ORIGIN,%20OCCURRENCE%20OF%20PETROLEUM.pdf 5. http://www.yourarticlelibrary.com/essay/petroleum-formation-and-occurrence-of-petroleum-with-figure/25413 6. http://petrowiki.org/Origin_of_petroleum 7. http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000448GO/P000594/M022683/ET/1505974261E-TextHydrocarbonTraps.pdf 8. http://shodhganga.inflibnet.ac.in/bitstream/10603/41568/8/08_chapter_2.pdf 9. http://petrowiki.org/Types_of_logs
Course Outcomes	On completion of Course, the students should be able to *1. Discuss in detail about the origin, occurrence and properties of Coal* *2. Evaluate the age and occurrences of the coal* *3. Explain about the petrography of Coal* *4. Outline the origin and occurrences of the Petroleum* *5. Demonstrate the basics of petroleum geology and well logging*

18GEOU0622 -Coal and Petroleum Geology												
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	3	1
CO2	3	1	1	1	2	1	1	3	2	1	3	1
CO3	3	1	1	3	2	1	1	3	1	1	3	1
CO4	3	1	1	1	2	1	1	3	1	2	3	1
CO5	3	2	1	1	3	1	1	3	2	1	3	1

Course Code & Title	**18GEOU0623** **Applied Geology**		
Class	**B. Sc. Geology**	**Semester**	**VI**
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • *To Coordinate several types of Geophysical surveys* • *To improve the knowledge of exploration by using modern techniques* • *To Summarize the Geological knowledge towards the mineral exploration* • *To Assess the best methods to Petroleum exploration, Groundwater Exploration* • *To find the suitable structure for Engineering applications.*		

Unit	Content	No. of Hours
I	**Mineral Exploration**: Introduction – Objectives – **Methods of Geological Investigations:** Surface investigations – Sub surface explorations. ***Geophysical Investigations***: **Electrical methods:** Principle – self potential method – Potential drop methods – Resistivity methods – Applications.	13 Lectures
II	**Mineral Exploration**: **Seismic methods**: principle – Refraction method – Reflection methods – Applications. **Gravitational methods**: Principle – Methods and corrections – Applications. **Magnetic methods:** Principle – Methods – Applications.	13 Lectures
III	**Petroleum Exploration: Petroleum prospect**: Discovery – **Geological factors - Economic factors.**	13 Lectures
IV	**Groundwater Exploration: Geological investigations:** Geological maps – Aerial photographs& Remote sensing – Test drilling. ***Geophysical Investigations***: Electrical resistivity method: Wenner configuration.	13 Lectures
V	**Engineering Geology**: Geological considerations for the constructions of **Dams: Tunnels: Roads and Bridges**.	13 Lectures
	Text Books: 1. ParbinSingh, B., A Textbook of Engineering and General Geology. S.K. Kataria&Sons, Delhi, 2005. 2. Arogyaswamy., R.N.P., Courses in Mining Geology, CBS Publishers &Distributors pvt. Ltd., New Delhi, 1995. 3. Levorsen A.I., Geology of Petroleum, CBS Publishers and Distributors, Delhi, Second Edition, 1985.	

References	**Reference Books:** 1. RamachandraRao, M.B., Outlines of Geophysical Prospecting. EBD, Dhanbad, 1993. 2. Lowrie, W., Fundamentals of Geophysics. 2nd ed.Cambridge University Press, NewDelhi, 2007. 3. Telford, W. M., Geldart, L. P. & Sheriff, R. E., AppliedGeophysics. 2nd ed. Cambridge University Press,New Delhi, 1990. 4. David Keith Todd, Larry W. Mays, Groundwater Hydrology, Wiley, 2013. *5. Underlined Titles are available at Swayam portal.* **Web Resources:** 1. https://archive.epa.gov/esd/archive-geophysics/web/html/index-7.html 2. http://www.geosearches.com/seismic.php 3. https://geoinfo.nmt.edu/geoscience/projects/astronauts/gravity_method.html 4. https://csegrecorder.com/articles/view/magnetic-and-gravity-methods-in-mineral-exploration 5. https://www.omicsonline.org/open-access/groundwater-exploration-for-water-well-site-locationsusinggeophysical-survey-methods-2157-7587-1000226.php? aid=69101 6. http://www.indiawaterportal.org/sites/indiawaterportal.org/files/Groundwater%20Exploration_An%20Introduction_TS%20Badrinarayanan.pdf 7. http://tsbm.co.in/myworks/mynotes/EngGeology/Structural%20Geology-II%20(Dams%20&%20Tunnels).pdf 8. http://ybu.edu.tr/muhendislik/insaat/contents/files/DAMS1(1).pdf 9. https://www.ideals.illinois.edu/bitstream/handle/2142/78856/geologicfactorsi13smit.pdf ?sequence
Course Outcomes	On completion of Course, the students should be able to *1. Explain the various methods of Mineral exploration by using electrical method.* *2. Use of Seismic, Gravitational and Magnetic methods in mineral exploration* *3. Discuss in detail about the petroleum Exploration* *4. Demonstrate the methods of groundwater exploration* *5. Outline the basics of engineering geology and its applications.*

18GEOU0623 - Applied Geology												
CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	2	1	3	2	1	1	3	1	2	3	1
CO2	3	3	1	2	3	1	1	3	3	2	2	1
CO3	3	2	1	2	3	1	1	3	2	2	3	1
CO4	3	3	1	2	3	1	1	3	3	2	2	1
CO5	3	2	1	1	3	1	1	3	2	2	3	2

Course Code & Title	**18GEOU0624** **Economic Geology practical**		
Class	**B. Sc Geology**	**Semester**	**VI**
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To Examine the Physical properties of the economic important minerals. • To classify the Economic minerals based on chemical composition • To Evaluate the Origin and Occurrences of the Economic minerals • To Summarize the distribution of Economic important minerals		

Unit	Contents
	Economic Geology: Megascopic identification, description of visible characteristics, mode of occurrence and uses of the following a) **Industrial Minerals**: magnesite, gypsum, asbestos, fluorite, calcite, graphite, barite, talc, witherite, strontianite, anhydrite, halite, dolomite, aragonite, kaolin, garnet, corundum, phosphate nodule. b) Megascopic identification, description of visible characteristics, mode of occurrence and uses of the following **Fe ores**: magnetite, hematite, limonite, pyrite, marcasite and siderite. c) Megascopic identification, description of visible characteristics, mode of occurrence and uses of the following **Cu ores**: chalcopyrite, cuprite, bornite, malachite, azurite, native copper. d) Megascopic identification, description of visible characteristics, mode of occurrence and uses of the following **Mn ores**: pyrolusite, psilomelane, rhodochrosite, and rhodonite. e) Megascopic identification, description of visible characteristics, mode of occurrence and uses of the following **Pb ores:**galena, cerussite, anglesite. f) Megascopic identification, description of visible characteristics, mode of occurrence and uses of the following **Zn ores**: smithsonite, sphalerite. g) Megascopic identification, description of visible characteristics, mode of occurrence and uses of the following **Sn ore:** cassiterite h) Megascopic identification, description of visible characteristics, mode of occurrence and uses of the following **As and Sb ores**: realgar, orpiment, stibnite i) Megascopic identification, description of visible characteristics, mode of occurrence and uses of the following **Miscellaneous ores**: wolframite, molybdenite, bauxite, chromite, ilmenite, rutile, cinnabar. j) Megascopic identification, description of visible characteristics, mode of occurrence and uses of the following **Radioactive Ores**: monazite, zircon, pitchblende, and pyrochlore.

	Ore Analysis: Identification of the following Ore mineral powders qualitatively by using blowpipe methods. a) Calcite, b) dolomite, c) magnesite, d) gypsum, e) bauxite, f) apatite, g) anhydrite, h) celestite, i) barite, j) magnetite, k) hematite, l) chromite, m) galena, n) pyrolusite, o) psilomelane, p) stibnite, q) sphalerite, r) cuprite, s) wolframite, t) malachite and smithsonite
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.*

18GEOU0624 -Economic Geology practical												
CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	2	1	1	2	1	1	3	1	2	3	1
CO2	3	3	1	2	3	1	1	3	1	1	2	1
CO3	3	3	1	2	3	1	1	3	1	1	2	1
CO4	3	3	1	2	3	1	1	3	1	1	2	1
CO5	3	3	1	2	3	1	2	3	1	2	3	1

Course Code & Title	**18GEOU06M1** **Introduction to field Geology**		
Class	**B. Sc Geology**	**Semester**	**VI**
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To Introduce the Field geological techniques, • To Examine the topographic maps and • To summarize the field characteristics in the report.		

Unit	Content	No. of Hours
I	Introduction - Literatures and maps - Destruction of rocks - Physiography - Topographic expressions and relief - Inliers and outliers - requirements of the field - suggestions and precautions. **Equipment and Supplies:** General, Geological Hammers, Pocket and Hand Lenses, Hydrochloric Acid, Streak Plate, Pocket Magnet, Pocket Knife, Measuring Tapes and Scales, Haversack or Rucksack, Mohs Scale of Hardness, Cold Chisel, Protractors, Pocket Calculator, Cameras, Care and Upkeep of Instruments. **The compass and Clinometer:** The compass and its uses- Dip of the compass needle - Magnetic declination **- Clinometer:** Bearing and Reading directions - Measuring altitudes - Handling of the compass.	11 Lectures
II	**Topographic maps:** Base Maps, Scale of maps – Depiction of relief - Latitudes and Longitudes - Map grids - Measurement of mapped areas- Mounting and folding field maps- Marking on maps. **Field documentation:** Field sketches and Drawings - Field photographs. **Basic field procedures:** Location - Soils and vegetation- measuring distances - Compass and tape traversing - Determination of slopes and gradients- Measuring difference in elevation - Field identification of rocks - Basic field observations.	11 Lectures
	Text Books: 1. Mathur, S. M., Guide to Field Geology. Prentice Hall 2. India. New Delhi, 2001. **3.** Compton, R. R., Geology in the Field, John Wiley & Sons Inc., New Delhi, 1985. 4. Gokhale, N.W., A Guide to Field Geology. CBS Publishers,New Delhi, 2001. **Reference Books:** 1. Coe, A. L. (ed)., Geological Field Techniques. Open University Press, Milton Keynes,	

References	UK, 2010. 2. Barnes, J. W., Basic Geological Mapping. John Wiley & Sons Inc., New Delhi, 2004. 3. Freeman, T., Procedures in Field Geology. John Wiley & Sons Inc., New Delhi, 1999 4. Lahee, F, Field Geology, CBS Publishers, New Delhi, 1987. **Web Resources:** 1. https://pubs.usgs.gov/gip/7000029/report.pdf 2. https://gem-a.com/images/Documents/JoG/2015/JoG-34-8-LR-3.pdf 3. *http://www.physicalgeography.net/fundamentals/2d.html* 4. *https://pubs.usgs.gov/gip/70039402/report.pdf* 5. *http://www.geographynotes.com/geology-2/structural-geology/uses-of-compass-clinometer-with-diagram-structural-geology/1437.* 6. *https://research.cnr.ncsu.edu/sites/woodlandstewardseries/wp-content/uploads/sites/15/2015/03/Using a Compass and Clinometer.pdf*
Course Outcomes	On completion of Course, the students should be able to 1. Explain about the features of field geology 2. Demonstrate the use of topographic maps and field equipment's

18GEOU06M1 - Introduction to field Geology												
CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	2	1	1	2	1	1	3	2	1	3	1
CO2	3	3	1	1	3	1	1	3	2	2	3	1

Course Code & Title	**18GEOU06M2** **Geological Mapping (Modular Course)**		
Class	**B. Sc Geology**	**Semester**	**VI**
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To introduce the geological mapping techniques and sampling techniques. • To study the fossils in the field. To identify the various structures of igneous, sedimentary and metamorphic rock in the field.		

Unit	Content	No. of Hours
I	**Geological Mapping:** General considerations - Reconnaissance - Surface features - Cuttings - Quarries and Mines - Unconsolidated and residual deposits - soils. **Systematic Mapping:** Strike and dip - Contacts and boundaries - correlation - Geologic cross- sections - Marking the map - Mapping on Aerial photographs. **Specimens and Sampling:** General - Trimming of Hand specimens - Fossil specimens - Mineral specimens - Samples and sampling - Numbering and labeling of specimens - packing and storage.	11 Lectures
II	**Study of Fossils and Biogenic structures. Field observations of Sedimentary rocks - Igneous rocks - Metamorphic rocks. Structures:** General, Top and bottom Strata - Joints - Unconformities - folds - faults. **Mineral Investigation and Identification**: General - Geological plan - Sampling - pitting and trenching.	11 Lectures
References	**Text Books:** 1. Mathur, S. M., Guide to Field Geology. Prentice Hall, India. New Delhi, 2001. **2.** Compton, R. R., Geology in the Field, John Wiley & Sons Inc., New Delhi, 1985. 3. Gokhale, N.W., A Guide to Field Geology. CBS Publishers, New Delhi, 2001. **Reference Books:** 1. Coe, A. L. (ed). Geological Field Techniques. Open University Press, Milton Keynes, UK, 2010. 2. Barnes, J. W., Basic Geological Mapping. John Wiley & Sons Inc., New Delhi, 2004. 3. Freeman, T., Procedures in Field Geology. John Wiley & Sons Inc., New Delhi, 1999 4. Lahee, F, Field Geology, CBS Publishers, New Delhi, 1987. **Web Resources:** 1. https://orkustofnun.is/gogn/unu-gtp-sc/UNU-GTP-SC-11-04.pdf 2. http://yunus.hacettepe.edu.tr/~kdirik/Barnes%202004%20-%20Basic%20Geological%20Mapping.pdf	

	3. https://profiles.uonbi.ac.ke/cnyamai/classes/sgl-308-introduction-geological-field-mappingfieldwork 4. https://www.eolss.net/Sample-Chapters/C01/E6-64-01-04.pdf 5. http://funnel.sfsu.edu/students/frankv/gcourses/Students/Nolen%20Brown/FIELD%20METHODS/Geological%20Field%20Techniques.pdf 6. http://www.montana.edu/earthsciences/fieldcampprograms/documents/Intro-Field-Mapping_Lageson.pdf
Course Outcomes	On completion of Course, the students should be able to *1. Explain in detail about the Geological mapping and sampling techniques* *2. Identify and demonstrate the fossils, structures of igneous, sedimentary and metamorphic rocks and minerals in the field.*

18GEOU06M2 -Geological Mapping (Modular Course)												
CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	2	1	1	2	1	1	3	2	2	3	1
CO2	3	2	1	1	2	1	1	3	1	1	3	1

Course Code & Title	**18GEOU04E1** **Introduction to Remote Sensing and GIS (Major Elective)**		
Class	**B. Sc Geology**	**Semester**	**VI**
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To introduce the principles and methods of Remote Sensing • To Evaluate the use of Aerial photographs in Geology • To Classify the types of remote sensing • To Describe the application of remote sensing • To Demonstrate the fundamentals of Geographic Information System		

Unit	Content	No. of Hours
I	**Fundamental Concept of Remote sensing:** Early history - Electromagnetic energy - Characteristics of Electromagnetic Energy - Energy interactions with earth surface features: vegetation, soil, water, snow and clouds.	12 Lectures
II	**Sensor systems used in remote sensing: Passive systems:** Photographic camera, Television camera, Return beam vidicon, Electro optical scanner, Imaging system. **Active systems:** Radar**. Remote sensing data acquisition. Reference data. Remote Sensing satellites: Landsat - Indian remote sensing satellites.**	12 Lectures
III	**Aerial Photography:** Types of Aerial photographs - Geometry of aerial photographs: Oblique, Vertical and Stereopair. Scale of Photographs: Determination of scale - Relief displacement - Stereoscopes – Parallax Bar.	12 Lectures
IV	**Remote Sensing Applications:** Mineral resources - Mapping of Land use/Landcover - Agriculture - Forestry - Water resources: Detection of water pollution - - Monitoring Environmental hazards	12 Lectures
V	**Geographic Information System:** Content of GIS - Use of Remote Sensing data in GIS - Spatial elements, data encoding and storage - Data manipulation - Data output.	12 Lectures
	Text Books: 1. Guha, P.K., Remote Sensing for the Beginner, Affiliated East- west press Pvt Ltd, New Delhi, 2003. 2. Curran, P.B. Principles of Remote Sensing. ELBS. London, 1985. **Reference Books:**	

References	1. Pandey, S.N. Principles and Applications of Photo geology. Wiley Eastern. New Delhi, 1989 2. Lillesand, T.M & R.W. Kiefer. Remote Sensing and Image Interpretation, Wiley, Delhi, 2000. 3. Sabins, F.F. Remote Sensing Principles and Interpretation. Freeman, New York, 1974. 4. Reddy, A. Principles of Remote Sensing and GIS. CBS. Delhi, 2010. **Web Resources:** 1. http://sar.kangwon.ac.kr/etc/rs_note/rsnote/cp1/cp1-1.html 2. https://www.uprm.edu/biology/profs/chinea/gis/g06/NRC2_1_2_9.pdf 3. https://gisgeography.com/passive-active-sensors-remote-sensing/ 4. https://www.nrcan.gc.ca/earth-sciences/geomatics/satellite-imagery-air-photos/air-photos/about-aerial-photography/9687 5. https://www.environmentalscience.org/principles-applications-aerial-photography 6. https://www.tankonyvtar.hu/en/tartalom/tamop425/0027_DAI6/ch01s05.html 7. http://grindgis.com/remote-sensing/remote-sensing-applications 8. https://researchguides.library.wisc.edu/GIS 9. https://gisgeography.com/what-gis-geographic-information-systems.
Course Outcomes	On completion of Course, the students should be able to *1. Explain the fundamentals of Remote Sensing* *2. Discuss the various types of Sensor systems* *3. Demonstrate about the aerial remote sensing* *4. Evaluate the Application of Remote sensing in various fields* *5. Outlines of Geographic Information System.*

18GEOU04E1 - Introduction to Remote Sensing and GIS (Major Elective)												
CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	3	1	2	3	1	1	3	2	2	3	1
CO2	3	3	1	2	3	1	1	3	2	2	3	1
CO3	3	3	1	2	3	1	1	3	2	2	3	1
CO4	3	1	1	2	2	1	1	3	2	2	3	1
CO5	3	3	1	2	3	1	1	3	2	2	3	1

Course Code & Title	**18GEOU04E2** **Hydrogeology (Major Elective)**		
Class	**B. Sc Geology**	**Semester**	**VI**
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To Describe about the Hydrologic cycle • To Classify the types of Aquifers • To Evaluate the Groundwater movement • To Estimate the quality of Groundwater • To Assess the methods of Groundwater recharge structures.		

Unit	Content	No. of Hours
I	**Hydrogeology:** Definition and scope of Hydrogeology - *Hydrologic cycle* – *Hydrosphere* – *Groundwater: Introduction* - origin and *occurrences of ground water*, meteoric water, connate water and Juvenile water – vertical distribution of ground water – zone of aeration, zone of saturation and water table. Springs – geological conditions favoring development of springs.	12 Lectures
II	**Aquifers**: Definition and types of aquifers: unconfined, confined, leaky and perched aquifers. Confining layers of aquifers: aquitard, aquifuge and aquiclude. Isotropic, anisotropic aquifers and layered aquifers. Aquifer properties: transmissivity, storativity, and compressibility. Artesian wells. Determination of subsurface water flow: field and graphical methods. Artesian wells, peizometric surface.	12 Lectures
III	Rock properties affecting Ground Water, openings in rocks. Types of openings – primary openings – secondary openings. Porosity, specific yield, specific retention and permeability. *Ground water movement* - forces causing ground water movement: seepage, capillary movement, laminar flow, turbulent flow, Darcy's law co-efficient of permeability and field measurement of permeability. Groundwater fluctuations and their causes.	12 Lectures
IV	Artificial and natural recharge of groundwater. Brief account of rain water harvesting. *Ground water quality* – physical, Bacterial, and chemical qualities – drinking water standards – major ions affecting chemical quality of ground water. *Groundwater Exploration.*	12 Lectures
V	Ground water recharge: natural and artificial recharge. Water wells – types of wells – well construction and development – collector wells and infiltration galleries. Outline of drilling techniques for groundwater.	12 Lectures

References	**Text Books:** 1. Todd, D.K., Mays, L.M., Groundwater Hydrology, Wiley, 2013. 2. Fetter, C.W, Applied Hydrology, CBS Publications, 2007. 3. Herman Bouwer, Groundwater Hydrology, McGraw hill, 2014. 4. Raghunath, H.M., Groundwater, New age international publications, 2003. **Reference Books:** 1. Davis, S.N., & R.J.M. De Wiest., Hydrogeology. Wiley. Delhi, 1966. 2. Freeze, R.A. & J.A. Cherry., Groundwater. Prentice Hall. New York, 1979. 3. Raghunath, H.M., Groundwater. East West Pub. Delhi, 1988. 4. Raghunath, H.M., Hydrology. East West Pub. Delhi, 1985. 5. Fetter, G.W. Applied Hydrogeology. CBS. Delhi, 1989. 6. Ramakrishnan, S. (2011). Ground Water. Scitech Publications. Chennai. 7. Garg, S.P., Groundwater and Tube Wells. Oxford & IBH. Delhi., 1982. 8. Underlined Titles are available in Swayam portal. **Web Resources:** 1. http://www.geographynotes.com/essay/groundwater-origin-sources-and-other-details-with-diagram/620 2. http://www.hwe.org.ps/Education/Birzeit/GroundwaterEngineering/Chapter%201-%20Occurrence%20of%20groundwater.pdf 3. http://www.indiawaterportal.org/sites/indiawaterportal.org/files/Vertical%20Distribution%20of%20Groundwater_ACWADAM_2010.pdf 4. http://techalive.mtu.edu/meec/module04/Basics3.html 5. http://wellwater.oregonstate.edu/groundwater-movement. 6. https://pubs.usgs.gov/sir/2005/5168/pdf/sir2005-5168_6.pdf 7. http://www.klimatanpassning.se/en/climate-change-in-sweden/streams-and-groundwater/groundwater-level-fluctuations-1.97833.
Course Outcomes	On completion of Course, the students should be able to 1. Discuss the origin and occurrence of groundwater 2. Classify types of aquifers 3. Describe Ground water movement 4. Analysis the Ground water quality *5.* Evaluate the Ground water recharge

18GEOU04E2 -Hydrogeology (Major Elective)												
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	3	1
CO2	3	1	2	1	2	2	1	3	2	2	3	1
CO3	3	2	1	2	2	1	1	3	1	1	3	1
CO4	3	3	1	2	3	1	1	3	2	2	3	1
CO5	3	2	1	2	3	1	1	3	2	2	3	1

Course Code & Title	**18GEOU05E1** **Mining Geology (Major Elective)**		
Class	**B. Sc Geology**	**Semester**	**VI**
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • *To Introduce fundamental concepts of various mining methods* • *To Assess the Explosives used in the mining* • *To Classify the types of mining* • *To Describe the sampling methods* • *To Demonstrate the ore separation process.*		

Unit	Content	No. of Hours
I	Mining Methods: **Mining terminology**: Exploitation – Development – Shaft – Hanging wall – Adit – Drive – Level – Cross cut – Tunnel – Raise – Winze- Stope- Ventilation stopping – Fire stopping – **Excavations and its types**. **Drilling:** Percussion drills – Rotary drills – Miscellaneous drilling methods – drill sampling.	12 Lectures
II	**Explosives**: Low explosives – High explosives – sheathed explosives – permitted explosives – Liquid oxygen – AN/FO and slurry types. **Classification of mining methods:** ***Alluvial mining*****:** Pan and batea – Rocker **–** Longtom – Sluicing- Derrick and cableway – Hydraulicking – Drift mining- Dredging.	12 Lectures
III	***Opencast mining*****:** Loading by manual – Loading by machines- Glory hole – Kaolin mining. **Underground mining**: Open stopes: Overhand stopping: Timbered stopes – Filled stopes – Shrinkage stopes – Mitchell slicing system. **Caving methods:** Top slicing – sub level caving – Block caving.	12 Lectures
IV	***Coal mining methods*****:** Pillar method – Longwall advancing – Longwall retreating – Horizon mining – Underground hydraulic mining – strip mining. **Sampling:** Coning and quartering- Diamond drill sampling – Sampling placers.	12 Lectures
V	**Ore dressing**: Crushing – Grinding – Sizing – classification – Air sizing – Electrical Precipitation of dust. **Concentration**: Washing and scrubbing – Gigging – Tabling – Vanners - Floatation. **Magnetic separation: Electrostatic separation.**	12 Lectures
	Text Books: 1. Arogyaswamy., R.N.P., Courses in Mining Geology, CBS Publishers & Distributors pvt. Ltd, New Delhi, 1995. **2.** Parbin Singh, "Engineering and General Geology", S. K. Kataria& Sons, New Delhi,	

References	2013. **Reference Books:** 1. Thomas, R. t., Introduction to mining Methods, McGraw Hill, New York, 1986. 2. Peters, W. C., Exploration and mining Geology, Wiley, New York, 1978 3. McKinstry, H. E., Mining Geology, Asia Publishing House, Delhi, 1948 4. Gaudin, A. M., Principles of Mineral Dressing, TMH, Delhi, 1939 5. Taggart, A. F., Handbook of Mineral Dressing, Chapman and Hall, Delhi, 1945. 6. *Underlined Titles are available at Swayam portal*. **Web Resources:** 1. http://www.aadnc-aandc.gc.ca/eng/1100100028056/1100100028058 2. https://everydayoil.wordpress.com/2012/11/16/different-types-of-drilling-and-its-breif-description/ 3. http://www.cienciaviva.pt/img/upload/Introduction%20to%20mining.pdf. 4. https://www.americangeosciences.org/critical-issues/faq/what-are-main-mining-methods 5. http://emfi.mines.edu/emfi2011/Coal%20Mining%20Methods%20-%20EMFI%20Summary.pdf 6. https://www.kau.edu.sa/Files/0052737/Subjects/(8)%20Ore%20processing%20(beneficiation).pdf
Course Outcomes	On completion of Course, the students should be able to *1. Explain about the basics of mining Geology* *2. Discuss the Various mining methods* *3. Demonstrate the Opencast mining* *4. Discuss the Coal mining methods* *5. Outline the Ore separation processes.*

18GEOU05E1 -Mining Geology (Major Elective)												
CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	2	1	2	2	1	1	3	2	2	3	1
CO2	3	3	1	2	3	1	1	3	2	2	3	1
CO3	3	2	1	2	2	1	1	3	1	1	3	1
CO4	3	2	1	2	2	1	1	3	1	1	3	1
CO5	3	1	1	1	2	1	1	3	1	1	3	1

Course Code & Title	**18GEOU05E2** **Earth and Climate (Major Elective)**		
Class	**B. Sc Geology**	**Semester**	**VI**
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To Analyze the climate system • To Classify the layers of Atmosphere • To Evaluate the Climate changes • To Explain Orbital Cyclicity and Climate • To Summarize mechanism of Monsoon.		

Unit	Content	No. of Hours
I	**Climate System: Forcing and Responses:** Components of the climate system. Climate forcing, Climate controlling factors. Climate system response, response rates and interactions within the climate system. Feedbacks in climate system. **Heat budget of Earth:** Incoming solar radiation, receipt and storage of heat transformation. Earth's heat budget. Interactions amongst various sources of earth's heat.	12 Lectures
II	**Atmosphere – Hydrosphere:** Layering of atmosphere and atmospheric Circulation. Atmosphere and ocean interaction and its effect on climate. Heat transfer in ocean. Global oceanic conveyor belt and its control on earth's climate. Surface and deep circulation. Sea ice and glacial ice.	12 Lectures
III	**Response of Biosphere to Earth's Climate:** Climate change: natural vs. anthropogenic effects. Humans and climate change. Future perspectives. Brief introduction to archives of climate change. Brief introduction to palaeoclimate. Palaeoclimate data from India.	12 Lectures
IV	**Orbital Cyclicity and Climate:** Milankovitch cycles and variability in the climate. Glacial-interglacial stages. The last glacial maximum (LGM). Pleistocene Glacial-Interglacial cycles. Younger Dryas. Isotope Paleontology.	12 Lectures
V	**Monsoon:** Mechanism of monsoon. Monsoonal variation through time. Factors associated with monsoonal intensity. Effects of monsoon.	12 Lectures
	Text Books: 1. Rudiman, W.F., 2001. Earth's climate: past and future. Edition 2, Freeman Publisher. 2. Rohli, R.V., and Vega, A.J., 2007. Climatology. Jones and Barlatt. **Reference Books:** 1. Lutgens, F., Tarbuck, E., and Tasa, D., 2009. The Atmosphere: An Introduction to	

References	Meteorology. Pearson Publisher. 2. Aguado, E., and Burt, J., 2009. Understanding weather and Climate. 5th Edition, Pearson Publisher 3. Dorothy Merritts, Kirsten Menking and Andrew deWet, 2014. Environmental Geology: An Earth Systems Science Approach. Edition 2, W.H. Freeman and Co Ltd. **Web Resources:** 1. http://funnel.sfsu.edu/students/frankv/gcourses/Students/Adam%20Rincon/Earths_Climate-Past_and_Future.pdf 2. http://nas-sites.org/americasclimatechoices/files/2012/06/19014_cvtx_R1.pdf 3. http://danida.vnu.edu.vn/cpis/files/Books/Atmosphere%20Weather%20and%20Climate%208th%20ed%20-%20R%20Barry%20R%20Chorley%20%20Routledge%202003%20WW.pdf
Course Outcomes	On completion of Course, the students should be able to *1. Explain fundamental concept of Climate system* *2. Discuss the various layers of Atmosphere* *3. Demonstrate Earth's climatic conditions* *4. Understand the variability in the climate* *5. Outlines of mechanism of monsoon variations*

18GEOU05E2 - Earth and Climate (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	1	3	1	1	2	1
CO2	3	1	1	1	2	1	1	3	2	1	2	1
CO3	3	1	1	1	2	1	1	3	1	1	2	1
CO4	3	1	1	1	2	1	1	3	2	1	2	1
CO5	2	2	1	2	2	1	1	2	1	1	1	1

Courses offered to Other Departments

Course Code & Title	**18GEOU03N1** **Engineering Geology**		
Class	B.Tech Civil Engineering	**Semester**	**III**
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To Understand the basics of Geology • To Describe the various minerals • To Demonstrate the various rock types • To illustrate the various types of structures • To Summarize the application of Geology in Engineering construction		

Unit	Content	No. of Hours
I	**GENERAL GEOLOGY:** Geology in Civil Engineering – Branches of Geology – Earth Structures and Composition – Elementary Knowledge on Continental Drift and Plate Technologies. Earth Processes – Weathering – Geological Work of Rivers, Wind and Sea and their Engineering Importance – Earthquake Belts in India. Groundwater – Mode of Occurrence – Prospecting – Importance in Civil Engineering.	13 Lectures
II	**MINERALOGY:** Elementary Knowledge on Symmetry Elements of Important Crystallographic Systems – Physical Properties of Minerals – Study of the Following Rock Forming Minerals – Quartz Group, Feldspar Group, Pyroxene Group, Amphibole Group and Mica Group. Fundamentals of Process of Formation of Ore Minerals – Identification of Minerals - Coal and Petroleum – Their Origin and Occurrence in India.	13 Lectures
III	**PETROLOGY**: Classification of Rocks – Distinction between Igneous, Sedimentary and Metamorphic Rocks. Description of Structures, Textures and Mode of Occurrence, Engineering Properties, Distribution and uses of following rocks. Igneous Rocks – Granite, Syenite, Diorite, Gabbro, Pegmatite, Dolerite and Basalt; Sedimentary Rocks - Sandstone, Limestone, Shale, Laterite, Conglomerate and Breccia; Metamorphic Rocks - Quartzite, Marble, Slate, Phyllite, Gneiss, Charnockite and Schist – Identification of Rocks.	13 Lectures
IV	**STRUCTURAL GEOLOGY AND GEOPHYSICAL METHOD:** Attitude of Beds – Outcrops – Introduction to Geological Maps – Study of Structures – Folds: Parts, classification of folds, Causes of folding. Faults: Parts, classification of fold, Causes of folding. Joints: Classification and	13 Lectures

	Occurrence and origin of joints – Importance of structures on Engineering Construction. Seismic and Electrical Methods for Civil Engineering Investigations.	
V	**GEOLOGICAL INVESTIGATIONS IN CIVIL ENGINEERING:** Geological Conditions necessary for Construction of Reservoirs and Dams, Tunnels, Buildings, Road Cuttings - Important building stones - Improvement of sites. Causes and Preventions of Land Slides –. Sea Erosion and Coastal Protection structures.	13 Lectures
References	**Text Books:** 1. Parbin Singh., Engineering and General Geology, S.K. Kataria & Sons, 2. Katson Publishing House, Ludhiana, 8th Edition, 2012. 3. Chenna Kesavulu N. "Textbook of Engineering Geology", Macmillan India Ltd., 2009 4. Venkat Reddy D. Engineering Geology, Vikas Publishers, 2010. **Reference Books:** 1. Krynine and Judd. "Engineering Geology and Geotechniques", CBS Publishers, 2005. 2. Tyrrell "Principles of Petrology", B.I. Publications, Bombay 1989 3. Billings P Marland. "Structural Geology", 3rd Edition, Phi Learning, 2008 4. Varghese P. C "Engineering Geology for Civil Engineers", Phi Learning Private Ltd, M-97, Connaught Circus, New Delhi -2012 **Web Resources:** 1. https://web2.mlp.cz/koweb/00/04/24/15/79/physical_geology.pdf 2. http://krishikosh.egranth.ac.in/bitstream/1/2026977/1/BPT5507.pdf 3. http://www.kean.edu/~csmart/Observing/05.%20Plate%20tectonics.pdf 4. http://www.iitk.ac.in/nicee/EQTips/EQTip04.pdf 5. http://pages.geo.wvu.edu/~kammer/g100/StructuralGeology.pdf 6. http://www.tulane.edu/~geol113/STRUCTURAL-1.pdf 7. http://www.subsurfacesurveys.com/pdf/Methods.pdf 8. http://www.geosci.usyd.edu.au/users/prey/Patrice_Intro_to_SG.pdf 9. http://krishikosh.egranth.ac.in/bitstream/1/2034167/1/178.pdf 10. https://www.forgottenbooks.com/es/download/ElementsofMineralogy_10302484.pdf 11. https://www.tulane.edu/~sanelson/eens212/intro_textures.pdf 12. http://www.usu.edu/geo/shervais/G4500_PDF/METAMORPHIC%20PETROLOGY.pdf 13. http://www.library.utexas.edu/geo/folkready/entirefolkpdf.pdf 14. http://www.basichydrogeology.com/HydrogeologyLectureNotes-v2.3-LR.pdf	
Course Outcomes	On completion of Course, the students should be able to 1. *Describe the importance of Geology in Civil Engineering* 2. *Assess the role of structural features and rocks in civil constructions* 3. *Describe the different types of minerals and rocks* 4. *Predict the natural disasters to prevent failure of Civil Projects* 5. *Describe the investigating techniques for site selection*	

18GEOU04N1 -Disaster Management (Non Major Elective)												
CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	2	1	1	2	1	1	3	2	1	2	1
CO2	3	1	1	1	2	1	1	3	2	2	2	1
CO3	3	1	1	1	2	1	1	3	2	2	3	1
CO4	3	2	1	1	2	1	1	3	2	2	2	1
CO5	2	2	1	1	2	1	1	3	2	2	2	1

Course Code & Title	**18GEOU04N1** **Disaster Management (Non Major Elective)**		
Class		**Semester**	
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To Explain the importance of Earth Science in natural disaster mapping • To Classify the various types of Natural Disasters • To Describe the Disaster Mitigation and Management		

Unit	Content	No. of Hours
I	**Earth Sciences and Natural Disasters**: Origin of the earth, Interior of the Earth. Endogenic processes and exogenic processes of the Earth. Geological Time Scale. Definition of Disaster, Disaster, Nature and Socio-Economic Factors – Relations. Types of Disasters, Disaster Management; An Introduction, Disaster Management Cycle	12 Lectures
II	**Introduction to Natural Disasters I; Earthquakes**: Seismic waves, Origin, Classification and Causes of Earthquake, Earthquake Intensity Scale. **Volcanoes:** Structure, Classification and Products of Volcanoes. **Tsunami Disaster**, **Cyclone Disaster.**	12 Lectures
III	**Introduction to Natural Disasters II; Drought Disaster** and its management, and **climate change** and its management. Other disasters and their management. **Flood Hazard**. Occurrence of Floods in India	12 Lectures
IV	**Disaster Mitigation:** Mitigation strategies for earth quakes, landslides, floods, tsunami. cyclone, drought, climate change. Industrial environmental disaster: pollution. Gas leakage - chemical and fire accident. Human disaster: road and rail accidents, Biological Disasters,	12 Lectures
V	**Disaster Management:** Rescue -relief –rehabilitation. Short term and long-term rescue operations. Short term and long-term relief operations short term and long-term rehabilitation. Dams - water shed management.	12 Lectures
References	**Text Books:** 1. Bangar, K.M., Principles of Engineering Geology, Nem Chand Jain Publishers, 2010. 2. Parbin Singh, A text book of Engineering and general Geology, publishers of engineering and computer books, 2009. 3. Mukerjee. P.K., A textbook of Geology, Thirteenth Edition. The world press pvt. Ltd, 1997. **Reference Books:** 1. Grija Bhushan Mahapatra, A Text Book of Geology, CBS Publishers and Distributors, New Delhi, 1987.	

	2. Jonathan Turk and Graham R. Thompson, Environmental Geoscience, Saunders college division, 2000. 2. Pradyumna, P. Karan, Shanmugam, P. Subbiah., The Indian Ocean tsunami, Cambridge University press India Pvt. Ltd, 2012. 3. Santra S.C, Environmental Science, New central book agency, 2004. 4. Thomas D. Schneid, Disaster Management and Preparedness" Tata McGraw Hill, New Delhi, 2001. 5. Vinod K. Jain, Earth Science, CBS Publishers and Distributors, New Delhi, 2005. 6. Janet Edwards and Martin Gustafsson., Handbook for Vulnerability Mapping. Serdish Rescue Services Agency, 2007.
Course Outcomes	On completion of Course, the students should be able to • *Understate the importance of Earth Science in Disaster studies* • *Recognize the sources for the natural disasters* • *Identify the mitigation measures for the natural disasters* • *Apply Geological Knowledge in management of natural disasters* • *Design the suitable precautionary methods.*

18GEOU04N1 -Disaster Management (Non Major Elective)												
CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	2	1	1	2	1	1	3	2	1	2	1
CO2	3	1	1	1	2	1	1	3	2	2	2	1
CO3	3	1	1	1	2	1	1	3	2	2	3	1
CO4	3	2	1	1	2	1	1	3	2	2	2	1
CO5	2	2	1	1	2	1	1	3	2	2	2	1

Course Code & Title	**18GEOU04N2** **Applied Geology (Non Major Elective)**		
Class		**Semester**	
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To understand the basics of Geology • To Describe the various minerals • To Demonstrate the various rock types • To illustrate the various types of structures • To Summarize the application of Geology in Engineering construction		

Unit	Content	No. of Hours
I	**GENERAL GEOLOGY:** Branches of Geology – Earth Structures and Composition – Elementary Knowledge on Continental Drift and Plate Technologies. Earth Processes – Weathering – Geological Work of Rivers, Wind and Sea – Earthquake Belts in India. Groundwater – Mode of Occurrence – Prospecting.	12 Lectures
II	**MINERALOGY:** Elementary Knowledge on Symmetry Elements of Important Crystallographic Systems – Physical Properties of Minerals – Study of the Following Rock Forming Minerals – Quartz Group, Feldspar Group, Pyroxene Group, Amphibole Group and Mica Group. Fundamentals of Process of Formation of Ore Minerals – Identification of Minerals - Coal and Petroleum – Their Origin and Occurrence in India.	12 Lectures
III	**PETROLOGY**: Classification of Rocks – Distinction between Igneous, Sedimentary and Metamorphic Rocks. Description of Structures, Textures and Mode of Occurrence, Distribution and uses of following rocks. Igneous Rocks – Granite, Syenite, Diorite, Gabbro, Pegmatite, Dolerite and Basalt; Sedimentary Rocks - Sandstone, Limestone, Shale, Laterite, Conglomerate and Breccia; Metamorphic Rocks - Quartzite, Marble, Slate, Phyllite, Gneiss, Charnockite and Schist – Identification of Rocks.	12 Lectures
IV	**STRUCTURAL GEOLOGY AND GEOPHYSICAL METHOD:** Attitude of Beds – Outcrops – Introduction to Geological Maps – Study of Structures – Folds: Parts, classification of folds, Causes of folding. Faults: Parts, classification of fold, Causes of folding. Joints: Classification and Occurrence and origin of joints. Seismic and Electrical Methods for Geological prospecting.	12 Lectures
V	**GEOLOGICAL INVESTIGATIONS:** Geological Conditions necessary for Construction of Reservoirs and Dams, Tunnels, Buildings, Road Cuttings - Important building stones - Improvement of sites. Causes and	12 Lectures

	Preventions of Land Slides –. Sea Erosion and Coastal Protection structures.	
References	**Text Books:** 1. Parbin Singh. "Engineering and General Geology", S.K. Kataria & Sons, Katson Publishing House Ludhiana, 8th Edition, reprint 2011-12. 2. Venkat Reddy D. Engineering Geology, Vikas Publishers, 2010 ISBN-978-81259-9032. **Reference Books:** 1. Krynine and Judd. "Engineering Geology and Geotechniques", CBS 2. Publisher,2005 3. Tyrrell "Principles of Petrology", B.I. Publications, 1989. 4. Billings P Marland. "Structural Geology", 3rd Edition, PHI Learning, 2008. 4. Varghese P. C "Engineering Geology for Civil Engineers", PHI Learning 5. Private Ltd, M-97, Connaught Circus, New Delhi -2012. **Web Resources:** 1. https://web2.mlp.cz/koweb/00/04/24/15/79/physical_geology.pdf 2. http://krishikosh.egranth.ac.in/bitstream/1/2026977/1/BPT5507.pdf 3. http://www.kean.edu/~csmart/Observing/05.%20Plate%20tectonics.pdf 4. http://www.iitk.ac.in/nicee/EQTips/EQTip04.pdf 5. http://pages.geo.wvu.edu/~kammer/g100/StructuralGeology.pdf 6. http://www.tulane.edu/~geol113/STRUCTURAL-1.pdf 7. http://www.subsurfacesurveys.com/pdf/Methods.pdf 8. http://www.geosci.usyd.edu.au/users/prey/Patrice_Intro_to_SG.pdf 9. http://krishikosh.egranth.ac.in/bitstream/1/2034167/1/178.pdf 10. https://www.forgottenbooks.com/es/download/ElementsofMineralogy_10302484.pdf 11. https://www.tulane.edu/~sanelson/eens212/intro_textures.pdf 12. http://www.usu.edu/geo/shervais/G4500_PDF/METAMORPHIC%20PETROLOGY.pdf 13. http://www.library.utexas.edu/geo/folkready/entirefolkpdf.pdf 14. http://www.basichydrogeology.com/HydrogeologyLectureNotes-v2.3-LR.pdf.	
Course Outcomes	On completion of Course, the students should be able to 1. Explain about the internal structure of the Earth 2. Discuss about the various minerals and their physical properties 3. Describe about the igneous, metamorphic and sedimentary rocks. 4. Evaluate the structural features of the Earth 5. Discuss the Geological investigations for the construction of dams and reservoirs.	

18GEOU04N2 -Applied Geology (Non Major Elective)												
CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	2	1	1	2	1	1	3	2	1	2	1
CO2	3	1	1	1	2	1	1	3	2	2	3	1
CO3	3	1	1	1	2	1	1	3	1	2	2	1
CO4	3	2	1	1	2	1	1	3	2	2	2	1
CO5	3	3	1	1	2	1	1	3	2	2	3	1

Course Code & Title	**18GEOU05N1** **Environmental Geosciences (Non Major Elective)**		
Class		**Semester**	
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To Explain the importance of Earth Science in Environmental science • To Classify the various types of Natural Resources • To Illustrate the concept of Ecosystem • To Assess various types of Pollution and control measures • To Describe the Disaster Mitigation and Management		

Unit	Content	No. of Hours
I	**Environment Geology –** Definition, Importance and its Scope. Need for Public Awareness. **Natural Resources:** Resources and its Associated Problems. **Forest Resources**: Description and its condition.	12 Lectures
II	**Water Resources:** Surface and Groundwater. Uses and Exploitation. Flood, Drought, Conflicts f overwater. Dams, Benefits and Problems. **Mineral Resources:** Resource and Exploitation, Effects of Extraction on Environment.	12 Lectures
III	**Land Resources:** Land as a Resource, Land Degradation, Man induced landslides, Soil Erosion, Desertification. Role of Individual in Conservation natural Resources, Equitable use of resources for sustainable lifestyle.	12 Lectures
IV	**Ecosystem:** Concept of an Ecosystem, Structure and function of an ecosystem. Forest, Grass land, Desert, Aquatic Ecosystem. **Cause, effects and control measures** of Air pollution and Mine Pollution- Marine pollution, Marine pollution- Noise pollution.	12 Lectures
V	**Cause, effects and control measures** of Thermal pollution- Nuclear hazards- Solid and Radioactive waste management. Role of Individual in prevention of Pollution. **Disaster management:** Floods, Earthquakes, Cyclone and Landslides.	12 Lectures
	Text Books: 1. Arul.P, Text Book of Environmental Studies, Selvi publications, Thanjavur, 2011. 2. Bangar, K.M., Principles of Engineering Geology, Nem Chand Jain Publishers, 2010. **Reference Books:** 1. Grija Bhushan Mahapatra, A Text Book of Geology, CBS Publishers and Distributors, New Delhi, 1987.	

References	2. Jonathan Turk and Graham R. Thompson,Environmental Geoscience, Saunders college division, 2000. 3. Parbin Singh,A text book of Engineering and general Geology, publishers of engineering and computer books, 2009. 4. Pradyumna, P. Karan, Shanmugam, P. Subbiah., The Indian Ocean tsunami, Cambridge University press India Pvt. Ltd. 2012. 5. Santra S.C, Environmental Science, New central book agency, 2004. 6. Thomas D. Schneid, Disaster Management and Preparedness" Tata McGraw Hill, New Delhi, 2001. 7. Vinod K. Jain, Earth Science, CBS Publishers and Distributors, New Delhi, 2005.
Course Outcomes	On completion of Course, the students should be able to • *Understate the importance of Earth Science in Environmental science* • *Utilize the various natural resources wisely* • *prepare the mitigation measures for the Pollution* • *Apply Geological Knowledge in management of natural disasters* • *Design the suitable precautionary methods.*

18GEOU05N1 - Environmental Geosciences (Non Major Elective)												
CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	2	1	1	2	1	1	3	2	1	2	1
CO2	3	1	1	1	2	1	1	3	2	2	2	1
CO3	3	1	1	1	2	1	1	3	2	2	3	1
CO4	3	2	1	1	2	1	1	3	2	2	2	1
CO5	2	2	1	1	2	1	1	3	2	2	2	1

Course Code & Title	18GEOU03A1 Allied Geology - I		
Class		Semester	III
Cognitive Level	K-1		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To understand the basics of Geology • To Describe the Structural Geology • To Demonstrate the various types of Crystals • To illustrate the minerals and their occurrences		

Unit	Content	No. of Hours
I	**General Geology:** Definition and Scope of Geology. Origin of Solar System: Nebular and Planetesimals hypotheses. Introduction and outline of constitution and composition of earth's interior. Brief account of the important methods of determining the age of the Earth. Earthquakes and their effects. Short note on Seismograph and Seismogram. Richter's scale of earthquake intensity. Brief account of volcanoes.	12 Lectures
II	**Structural Geology:** Definition and scope of Structural Geology. Concept of rock outcrop - definition of dip and strike of rock formations. Folds: Definition and parts of a fold. Brief description of the following fold types: anticline, syncline, symmetrical, asymmetrical, isoclinal and recumbent folds. Brief description of the following fold systems: anticlinorium and synclinorium. Faults: Definition and parts of a fault. Brief description of the following types of faults: normal, reverse, strike, dip, oblique, parallel and steep faults. Brief outline of joints and unconformities.	12 Lectures
III	**Crystallography:** Definition of crystallography and crystals. Morphological characters of crystals: Faces - forms - edges. Symmetry elements of crystals: Axis, plane and center of symmetry. Miller's indices. Study of the following crystal systems: normal classes of the cubic, tetragonal, orthorhombic, monoclinic and triclinic systems.	12 Lectures
IV	**Mineralogy I:** Definition of mineralogy and mineral. Outline of physical properties of minerals: Color, form, luster, hardness, cleavage, fracture and specific gravity. Description of the following minerals: Quartz. Orthoclase - Microcline - Albite - Labradorite - Anorthite. Nepheline - Leucite - Sodalite. Enstatite - Hypersthene - Augite - Dipside.	12 Lectures
V	**Mineralogy II:** Description of the following minerals: Hornblende - Actinolite - Tremolite - Muscovite - Biotite - Chlorite. Topaz - Olivine -	12 Lectures

	Serpentine - Talc. Tourmaline - Beryl - Apatite - Corundum. Garnet - Diamond - Apatite - Staurolite - Sillimanite - Epidote.	
References	**Text Books:** 1. Parbin Singh. "Engineering and General Geology", S.K. Kataria & Sons, Katson Publishing House Ludhiana, 8th Edition, reprint 2011-12. 2. Venkat Reddy D. Engineering Geology, Vikas Publishers, 2010 ISBN-978-81259-9032. **Reference Books:** 1. Krynine and Judd. "Engineering Geology and Geotechniques", CBS 2. Publisher,2005 3. Tyrrell "Principles of Petrology", B.I. Publications, 1989. 4. Billings P Marland. "Structural Geology", 3rd Edition, PHI Learning, 2008. 5. Varghese P. C "Engineering Geology for Civil Engineers", PHI Learning 6. Private Ltd, M-97, Connaught Circus, New Delhi -2012. **Web Resources:** 1. https://web2.mlp.cz/koweb/00/04/24/15/79/physical_geology.pdf 2. http://krishikosh.egranth.ac.in/bitstream/1/2026977/1/BPT5507.pdf 3. http://www.kean.edu/~csmart/Observing/05.%20Plate%20tectonics.pdf 4. http://www.iitk.ac.in/nicee/EQTips/EQTip04.pdf 5. http://pages.geo.wvu.edu/~kammer/g100/StructuralGeology.pdf 6. http://www.tulane.edu/~geol113/STRUCTURAL-1.pdf 7. http://www.subsurfacesurveys.com/pdf/Methods.pdf 8. http://www.geosci.usyd.edu.au/users/prey/Patrice_Intro_to_SG.pdf 9. http://krishikosh.egranth.ac.in/bitstream/1/2034167/1/178.pdf 10. https://www.forgottenbooks.com/es/download/ElementsofMineralogy_10302484.pdf 11. https://www.tulane.edu/~sanelson/eens212/intro_textures.pdf 12. http://www.usu.edu/geo/shervais/G4500_PDF/METAMORPHIC%20PETROLOGY.pdf 13. http://www.library.utexas.edu/geo/folkready/entirefolkpdf.pdf 14. http://www.basichydrogeology.com/HydrogeologyLectureNotes-v2.3-LR.pdf..	
Course Outcomes	On completion of Course, the students should be able to • *Understate the importance of Earth Science* • *Discuss the various Earth's structures* • *Demonstrate the characters of the crystals* • *Evaluate the mineralogical characters*	

18GEOU03A1- Allied Geology - I												
CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	2	1	1	2	1	1	3	2	1	2	1
CO2	3	2	1	1	2	1	1	3	2	2	2	1
CO3	3	1	1	1	2	1	1	3	2	2	3	1
CO4	3	1	1	1	2	1	1	3	2	2	3	1

Course Code & Title	**18GEOU04A2 Allied Geology - II**		
Class		**Semester**	**IV**
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To understand the basics of Paleontology • To Describe the Stratigraphy • To Demonstrate Petrology • To illustrate the Economic minerals and their occurrences		

Unit	Content	No. of Hours
I	**Paleontology:** Definition of Paleontology and fossils. Outlines of modes of preservation in sedimentary rocks. Brief account of the uses of fossils. Study of the morphological characters and geological age of the following fossil groups: Pelecypods, gastropods, cephalopods, brachiopods, corals and trilobites**.**	12 Lectures
II	**Stratigraphy:** Definition and scope of Stratigraphy. Outline of the Geological Time scale. Brief account of the following geological formations in India: Dharwar Group, Cuddapah Group, Vindhyan Group, Gondwana Group, Cretaceous formations of Tiruchirapalli and Karewa formation.	12 Lectures
III	**Igneous Petrology**: Definition of Igneous petrology and igneous rocks. Forms of Igneous rocks: Sill, lopolith, laccolith, phacolith, dyke and batholith. Brief description of the following igneous rocks: dunite, pyroxenite, gabbro, dolerite, syenite, granite, pegmatite, aplite, andesite and basalt.	12 Lectures
IV	**Sedimentary petrology:** Definition of sedimentary rocks and sedimentary petrology. Primary structures of sedimentary rocks: common bedding, cross bedding, current bedding, graded bedding. Surface structures: ripple marks, mud cracks, and rain prints. Brief description of the following sedimentary rocks: Sandstone, arkose, grit, shale and limestone**.** **Metamorphic Petrology:** Definition of metamorphic rocks. Metamorphism and metamorphic process. Agents of metamorphism. Brief description of the following metamorphic rocks: Slate, phyllite, schist, gneiss, marble, quartzite, granulite, and amphibolite.	12 Lectures
	Economic Geology: An outline of the following process of Ore	12 Lectures

V	formation: magmatic - hydro thermal - placer - marine evaporites. Brief description of the physical properties and Indian occurrences of the following ore and industrial minerals: graphite, bauxite, magnesite, hematite, magnetite, chromite, gold, pyrolusite, pyrite, galena, asbestos, gypsum, chalk, calcite, dolomite, barite and kaolin. Brief description of the following coal types: peat, lignite, bituminous and anthracite. Brief introduction to petroleum, its origin and occurrences in India.	
References	**Text Books:** 1. Parbin Singh. "Engineering and General Geology", S.K. Kataria & Sons, Katson Publishing House Ludhiana, 8th Edition, reprint 2011-12. 2. Venkat Reddy D. Engineering Geology, Vikas Publishers, 2010 ISBN-978-81259-9032. **Reference Books:** 1. Krynine and Judd. "Engineering Geology and Geotechniques", CBS Publisher,2005 2. Tyrrell "Principles of Petrology", B.I. Publications, 1989. 3. Billings P Marland. "Structural Geology", 3rd Edition, PHI Learning, 2008. 4. Varghese P. C "Engineering Geology for Civil Engineers", PHI Learning Private Ltd, M-97, Connaught Circus, New Delhi -2012.	
Course Outcomes	On completion of Course, the students should be able to • Understate the importance of Paleontology and Stratigraphy • Discuss the Igneous Petrology • Discuss the Sedimentary petrology • Discuss the Metamorphic Petrology • Evaluate the Economic minerals uses, origin and distribution.	

18GEOU04A2 - Allied Geology - II												
CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	2	1	3	2	1	2	3	1	1	3	2
CO2	3	1	2	3	2	2	3	3	1	3	3	1
CO3	3	1	1	3	1	1	2	3	1	2	2	1
CO4	3	2	1	2	2	1	1	3	2	2	3	1
CO5	3	2	1	2	2	1	1	3	2	2	3	1

Course Code & Title	**18GEOU04A3** **Allied Geology – Practical I**		
Class		**Semester**	**IV**
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To know about the basic principles of Crystallography and their forms • To demonstrate Mineralogy • To classify the various types of minerals and their uses.		

Unit	**Contents**
	Crystallography: Simple forms of the Normal classes of the different crystal systems and models representing the following minerals: **Cubic system**: Galena, fluorite and garnet. **Tetragonal system**: Zircon, Cassiterite. **Hexagonal system**: Beryl. **Orthorhombic system**: Barite, sulfur, staurolite. **Monoclinic system**: Gypsum. **Triclinic System**: Axinite. **Mineralogy** Identification and physical description of the following minerals: **Quartz group**: rock crystal, chalcedony, agate, jasper, flint. **Feldspar group**: orthoclase, microcline, albite, perthite. **Pyroxene group**: augite, hypersthene. **Amphibole group**: hornblende, tremolite, actinolite. **Mica group**: muscovite, biotite, chlorite. **Other silicate minerals**: olivine, garnet, beryl, tourmaline, Staurolite. **Non-silicates**: corundum, apatite. **Ore minerals**: magnetite, chromite, bauxite, pyrolusite, pyrite, galena, hematite. **Industrial minerals**: talc, asbestos, Magnesite, barite, gypsum. **Coal varieties**: peat, lignite, bituminous, and anthracite.
Course Outcomes	On completion of Course, the students should be able to 1. *Demonstrate the various types of Crystals* 2. *Identify the various types of minerals* 3. *Describe the ore and industrial minerals.*

18GEOU04A3 - Allied Geology – Practical I

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

Course Code & Title	**18GEOU04A4** **Allied Geology – Practical II**		
Class		**Semester**	**IV**
Cognitive Level	**K-1**		
	K-2		
	K-3		
Course Objectives	**The Course aims** • To demonstrate Petrology • To understand the basics of Paleontology • To illustrate Geological maps		

Unit	Contents
	Petrology Identification and physical description of the following rocks: **Igneous rocks**: granite, pegmatite, syenite, diorite, gabbro, dolerite, dunite, pyroxenite. **Metamorphic rocks**: slate, mica schist, chlorite schist, hornblende gneiss, garnet-mica gneiss, granulite, marble. **Sedimentary rocks**: sandstone, conglomerate, arkose, grit, shale, limestone. **Fossils** Identification and physical description of the following fossils: **Pelecypods**: meretrix, arca, pecten, ostrea. **Gastropods**: turritella, natica, turbo, conus. **Cephalopods**: nautilus, acanthoceras. **Brachiopods**: terebratula, spirifer. **Trilobites:** calymene, paradoxites. **Corals:** lithostrotion. **Plant fossils:** glossopteris, ptillphyllum. **Geological maps** Geological maps drawing exercises: drawing strike lines and determining dip amounts. Outcrop completion geological maps with conformable series of beds. Preparation of geological sections for conformable series of beds.
Course Outcomes	On completion of Course, the students should be able to 1. *Classify the rock types* 2. *Identify the fossils.* 3. *Complete the Geological maps*

18GEOU04A4 - Allied Geology – Practical II

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