ALAGAPPA UNIVERSITY, KARAIKUDI
SYLLABUS UNDER CBCS PATTERN FOR AFFILIATED COLLEGES
WITH EFFECT FROM THE ACADEMIC YEAR 2022-23 ONWARDS

B.Sc. GEOLOGY
Programme structure

Sem.	Part	Course Code	Courses	Title ofthePaper	T/P	Credits	Hours/ Week	Max. Marks		
								Int.	Ext.	Total
I	I	2211T	T/OL	Tamil/OtherLanguages-I	T	3	6	25	75	100
	II	712CE	E	Communicative English -I	T	3	6	25	75	100
	III	22BGE1C1	CC	Dynamic Geology	T	5	5	25	75	100
		22BGE1C2	CC	Geomorphology	T	4	4	40	60	100
		-	AL - IA	Chemistry, Physics, Mathematics	T	3	3	25	75	100
		-	AL - IA	Practical- Respective Allied Theory Course	P	2	2	40	60	100
	IV	22BVE1	SEC -I	ValueEducation	T	2	2	25	75	100
		-	-	Library	-	-	2	-	-	-
				Total		**22**	**30**	**205**	**495**	**700**
II	I	2221T	T/OL	Tamil/OtherLanguages-II	T	3	6	25	75	100
	II	722CE	E	Communicative English - II	T	3	6	25	75	100
	III	22BGE2C1	CC	Palaeontology and General Stratigraphy	T	5	5	25	75	100
		22BGE2P1	CC	Practical- Palaeontology	P	4	4	40	60	100
		-	AL - IB	Chemistry, Physics, Mathematics	T	3	3	25	75	100
		-	AL - IB	Practical- Respective Allied Theory Course	P	2	2	40	60	100
	IV	22BES2	SEC-II	EnvironmentalStudies	T	2	2	25	75	100
		Naan Mudhalvan Course		Language Proficiency for Employability(Effective English)	-	2	2	25	75	100
				Total		**24**	**30**	**230**	**570**	**800**
III	I	2231T	T/OL	Tamil/OtherLanguages-II	T	3	6	25	75	100
	II	2232E	E	English for Enrichment - I	T	3	6	25	75	100
	III	22BGE3C1	CC	Crystallography & Optical Mineralogy	T	3	3	25	75	100
		22BGE3C2	CC	Mineralogy	T	3	3	25	75	100
		22BGE3P1	CC	Practical-II - Crystallography	P	3	3	40	60	100
		-	AL - IIA	Chemistry, Physics, Mathematics	T	3	3	25	75	100
		-	AL - IIA	Practical- Respective Allied Theory Course	P	2	2	40	60	100
	IV	22BE3	SEC-III	Entrepreneurship	T	2	2	25	75	100
		-	NME-I	1.Adipadai Tamil (or) 2.AdvanceTamil (or) 3.ITSkills for Employment (or) MOOC'S	T	2	2	25	75	100
				Total		**24**	**30**	**255**	**645**	**900**
IV	I	2241T	T/OL	Tamil/OtherLanguages -IV	T	3	6	25	75	100
	II	2242E	E	English for Enrichment - II	T	3	3	25	75	100
	III	22BGE4C1	CC	Indian Stratigraphy	T	4	4	25	75	100
		22BGE4C2	CC	Structural Geology	T	4	4	25	75	100
		22BGE4C3	CC	Practical–Mineralogy	P	3	3	40	60	100
		-	AL - IIB	Chemistry, Physics, Mathematics	T	3	3	25	75	100
		-	AL - IIB	Practical- Respective Allied Theory Course	P	2	2	40	60	100

	IV	-	NME-II	1.Adipadai Tamil (or) 2.AdvanceTamil (or) 3. Small Business Management / MOOC'S	T	2	2	25	75	100
		Naan Mudhalvan Course		Digital Skills for Employability – (Microsoft-Office Fundamentals)	-	2	3	25	75	100
				Total		**26**	**30**	**255**	**645**	**900**
V	III	22BGE5C1	CC	Igneous Petrology	T	4	4	25	75	100
		22BGE5C2	CC	Sedimentary and Metamorphic Petrology	T	4	4	25	75	100
		22BGE5C3	CC	Economic Geology	T	4	4	25	75	100
		22BGE5C4	CC	Field Geology	T	4	4	25	75	100
		22BGE5P1	CC	Practical- Petrology	P	4	6	40	60	100
		22BGE5P2	CC	Practical- Structural Geology, Field Geology and Economic Geology	P	4	6	40	60	100
	IV	-		Career development/ employability skills	-	-	2	-	-	-
				Total		**24**	**30**	**180**	**420**	**600**
VI	III	22BGE6I	DSE	Internship		24	26	150	250	400
	IV	Naan Mudhalvan Course		Employability Readiness* (Naandi /Unnati/Quest/IBM Skills build)	-	2	4	25	75	100
				Total		**26**	**30**	**175**	**325**	**500**
		(Or)								
	III	22BGE6E1	DSE	Regional Geology	T	6	6	25	75	100
		22BGE6E2		Photogeology, Remote Sensing, GIS and Mining Geology	T	6	6	25	75	100
		22BGE6E3		Hydrogeology and Engineering Geology	T	6	6	25	75	100
		22BGE6E4		Environmental Geology and Marine Geology	T	4	6	40	60	100
	IV	-	-	Library/Yoga etc	-	-	2	-	-	-
		Naan Mudhalvan Course		Employability Readiness* (Naandi /Unnati/Quest/IBM Skills build)	-	2	4	25	75	100
				Total		**26**	**30**	**125**	**375**	**500**
		(Or)								
	III	22BGE6PR	DSE	Project		6	8	25	75	100
		22BGE6E1		Regional Geology	T	6	6	25	75	100
		22BGE6E2		Photogeology, Remote Sensing, GIS and Mining Geology	T	6	6	25	75	100
		22BGE6E3		Hydrogeology and Engineering Geology	T	6	6	25	75	100
	IV	Naan Mudhalvan Course		Employability Readiness* (Naandi /Unnati/Quest/IBM Skills build)	-	2	4	25	75	100
				Total		**26**	**30**	**125**	**375**	**500**
				Grand Total		**146**	**--**	**--**	**--**	**4400**

*Employability Readiness -Women's Colleges Naandi course and all other Colleges IBM Skills build Course.

Sem.	Part	Course Code	Title of the Paper	Credits	Hrs./ Week	Max. Marks		
						Int.	Ext.	Total
I	III	71BEPP - I	Professional English for Physical Science-I	4	5	25	75	100
II		72BEPP - II	Professional English for / Physical Science-II	4	5	25	75	100
III		*	Professional English for Physical Science-III	4	5	25	75	100
IV			Professional English for Physical Science-IV	4	5	25	75	100

*The Syllabus of Professional English for III & IV Semester will be provided after Receiving the syllabus from TANSCHE.

As per TANSCHE, the Professional English book will be taught to allfour streams apartfrom the existing hours of teaching/additional hours of teaching (1hour/day) as a 4 creditpaper as an add on course on par with Major paper and completion of the paper is a must to continue his/her studies further.

- T/OL-Tamil/Other Languages,
- E–English
- CC-Corecourse– Corecompetency,criticalthinking,analyticalreasoning,researchskill&teamwork
- Allied –Exposure beyond the discipline
- AECC-- AbilityEnhancementCompulsoryCourse(ProfessionalEnglish&EnvironmentalStudies) - Additional academic knowledge, psychology and problem solving etc.,
- SEC-Skill Enhancement Course-Exposure beyond the discipline(ValueEducation,EntrepreneurshipCourse,Computerapplication for Science,etc.,
- NME -Non Major Elective–Exposure beyond the discipline
- DSE– Discipline specific elective –-Student choice– either or
    - Internship
    - Ifinternship– Marks=Internal=150(75+75)twomidtermevaluationthroughVivavoceandExternal250 marks(Report=150+VivaVoce=100)=Total400marks
    - Theory papersor
    - Project +3 theory papers.
- MOOCs–Massive Open Online Courses

*T- Theory, P- Practical

Semester –I				
Course code 22BGE1C1	**Core Course - I**	**T/P**	**C**	**H/W**
	DYNAMIC GEOLOGY	**T**	**5**	**5**
Objectives	➢ To know about the composition, origin and the age of the earth. ➢ To understand the Earth's various endogenetic processes like earthquake, volcanoes ➢ To understand the concepts of tectonics, distribution of plates, mechanism of plate movements and various theories of plate tectonics. ➢ To know about mountains and their classification ➢ To understand the origin of oceans and continents; theories of continental drift andthe supporting evidences.			
Unit -I	Geology: Introduction-Branches-Scope. Solar system – outer and inner planets. Earth as a member of the Solar system – its relation to other planets – size and density of the Earth. Origin of the Earth – Nebular, Planetesimal, Tidal, and Dust cloud hypotheses; their merits and demerits.			
Unit -II	Dating the rocks – Absolute and relative dating – An outline of radioactive and other dating methods. Age of the Earth. Volcanoes – types of volcanic eruption – central vent and fissure types; dormant and extinct volcanoes. Types of volcanic cones; classification of volcanoes based on the nature of volcanic activity; Products of volcanoes – distribution and causes of volcanism			
Unit -III	Earthquakes – Definition – Seismic waves, definition of Focus, Epicentre and isoseismal lines. Seismograph and seismogram – Time, distance graphs – effects and causes of earth quakes – Richter's scale of earthquake – Mercalli's intensity scale – Distribution of earthquake. Interior of the earth – the structure and constituents.			
Unit -IV	Mountains and mountain chains – Classification of mountains – origin of Tectonic mountains; contraction theory, continental drift theory, convection current and plate tectonic theories, Isostasy – concept; Airy's and Pratt's theories.			
Unit -V	Continental drift – concept and evidences – Theories for the continental drift (Taylor & Wegner). Sea floor spreading – definition and evidences. The concept of plate tectonics: a brief account on lithopheric plates, plate boundaries and mechanism of plate motion. Relief features – Ocean basins and Continents – their distribution.			

Reference and Textbooks:

Holmes, A. (1986). *Principles of Physical Geology*. ELBS Publications, UK.

Judson, S., Deffeyes, K.S., &Hargraves, R.B. (1978). *Physical Geology*, Prentice Hall of India, New Delhi.

Mahapatra, G.B. (2002). *A Text Book of Geology*, New Delhi: CBS publishers & Distributors.

Mathur, S.M. (2000). *Elements of Geology*, New Delhi: CBS publishers & Distributors.

Miller, W.J. (1938). *An Introduction to Physical Geology,* New York: D Van Norstrand company.

Panchuk, K. (2019). *Physical Geology*, University of SAKATCHEWAN: E-Resource PDF.

Plummer, Lisa, Hammersky, (2016). *Physical Geology* (15th ed.). E-Resource PDF.

Radhakrishnan, V. (1996). *General Geology*, TN: VVP Publishers, Tuticorin.

Saklani, P.S. (2006). *Tectonic Geology*, New Delhi: Satish serial publishing house.

Singh, G. (2009). *Earth Science Today*, New Delhi: Discovery publishing House Pvt, Ltd.

Thompson, & Turk, (1997). *Introduction to Physical Geology* E-Resource PDF.

Worcester, P.G. (1948). *A Text book of Geomorphology* (2nded.). New York: D Van Nor strand company.

Outcomes	Students acquire knowledge pertinent to the essentials of the structural dynamics of the earth; origin of our solar system and planets, including earth; processes in action within the earth and their impact on man and his institutions.

Semester –I				
Course code 22BGE1C2	**Core Course - II**	**T/P**	**C**	**H/W**
	GEOMORPHOLOGY	**T**	**4**	**4**

Objectives	➢ To gain knowledge about Earth's various exogenetic processes like weathering and mass movements and their types. ➢ To know about the Earth's atmosphere and its composition. ➢ To study the geological action of groundwater, wind, running water, glacier and sea.
Unit -I	Definition of geomorphic agent, gradation, degradation, aggradation. Classification of relief feature into I, II and III orders. Weathering – definition of processes, climatic influences and products. Types of weathering. Mass wasting –Slow flowage types and rapid flowage types.
Unit -II	The atmosphere, its composition and zones. Geological work and landforms produced by wind. Sand dunes and their types. Definition of Groundwater Water table -- Springs — Hot springs and Geysers. Geological work and landforms produced by groundwater. Karst topography.
Unit -III	Geological work and landforms produced by fluvial process. Base level of erosion – graded profile – rapids, cascades and water falls. Development of river valleys. Drainage patterns. River capture, river meandering, stream rejuvenation, river terraces, entrenched meanders, braided streams.
Unit -IV	Glaciers, definition; origin of glacier – types of glaciers and their movement. Glacial wastage – ablation and calving, icebergs. Geological action and landforms produced by Glacier. A brief outline on glacial epochs and causes of glaciations.
Unit -V	Seas and oceans – definition of continental margins – continental shelf, continental rise; abyssal plain. Waves, tides and currents. Landforms produced by marine processes. Shorelines – types of shorelines. An introduction on submarine canyons, sea mounts, guyots and mid oceanic ridges. Coral reefs, types and origin. Lakes; Origin and classification of lakes deposits and Indian lakes.

Reference and Textbooks:

Bloom, A.L. (1979). *Geomorphology*, New Delhi: Rawat publications.

Dayal, P. (2019). *A Text Book of Geomorphology*, New Delhi: Rajesh Publications.

Emmons et. al. (1939). *Principles of Geology*, McGraw Hill, New York & London.

Holmes, A. (1986). *Principles of Physical Geology*, UK: ELBS Publications.

Mahapatra, G.B. (2002). *A Text Book of Geology*, New Delhi: CBS publishers & Distributors.

Mathur, S.M. (2000). *Elements of Geology*, New Delhi: CBS publishers & Distributors.

Radhakrishnan, V. (1996). General *Geology*, TN: VVP Publishers, Tuticorin.

Savindra Singh, (2003). *Geomorphology*, Allahabad: PrayagPustakBhawan.

Thornbury, W. (2004). *Principles of Geomorphology*, New Delhi: CBS Publishers.

Worecester, P.G. (1948). *A text book of Geomorphology*, New York: D Van Norstrand company.

Outcomes	Leaners will be able to appreciate the mechanism of operation of various processes and the resultant landform development and modifications.

Semester - II				
Course code: 22BGE2C1	**Core Course III**	**T/P**	**C**	**H/W**
	PALAEONTOLOGY & GENERAL STRATIGRAPHY	**T**	**5**	**5**

Objectives

- To understand the origin of life, evolution through geological time and classification of organism
- To study the fossils, their types and applications, conditions for formation and modes of preservation
- To impart to the leaners the general morphology, classification, geologic history and stratigraphic importance of invertibrates, vertibrates and plant fossils of India.

Unit -I

Definition of Palaeontology, organic world, animal kingdom habits and habitats. Definition of fossil – Nature and modes of preservation of fossils – Zone fossils, index fossils, trace fossil uses of fossils. General morphology, classification and geological history of the following invertebrates.

Phylum Protozoa – order Foraminifera

Phylum Porifera – Sponges

Description of the following fossils.

Textularia, Globigerina, Nummulites, Fusulina, Siphonia.

Applications and uses of microfossils.

Unit -II

General morphology, classification and geological history of the following invertebrates.

Phylum Ceolenterata – Class Anthozoa (Corals)

Phylum Echinodermata – Classes Echinoidea, Crinoidea and Blastoidea

Description of the following fossils:

Ceolenterata :Zaphrentis, Cyathophyllum, Omphyma, Lithostrotion, Calceola, Montlivaltia, Isastrea, Thecosmilia Heliolites, Favosites and Halysites.

Echinodermata: Crinoids; Encrinus and Marsupites.

Blastoidea: Pentremites

Echinoidea: Cidaris, Hemicidaris, Stigmatopygus, Holaster and Micrraster

Unit -III

General morphology, classification and geological history of the following invertebrates.

Phylum Brachiopoda.

Phylum Mollusca – Classes Lamellibranchia (Pelecypoda), Gastropoda andCephalopoda.

Description of the following fossils

Brachiopoda:Lingula, Orthis, Productus, Penamerus, Rhynconella, Terebratula, Atrypa, Sprifier and Athyris.

Pelecypoda: Arca, Glycimeris (Pectenculus, Inoceramus, Ostrea, Alectryonia, Pecten, Plicatula, Spondylus, Trigonia, Pholadomya, Cardita, Hippurites, Cardium, Venus, Meretrix, Gryphaea and Exogyra.

Gastropoda: Bellerophon, Turbo, Trochus, Nautica, Turritella, Cerithium, Cyprea, Murex, Fuses, Voluta, Conus, Physa and Helix.

Cephalopoda: Orhtoceras, Nautilus, Goniatites, Ceratites, Phyilloceras, Lytoceras Acanthoceras, Scholenbachia, scaphites, Perisphinctus, Hamites, Turrilites, Baculites and Belemnites.

Unit -IV

General morphology, classification and geological history of the following invertebrates.

Phylum Arthropoda - Class Trilobita

Phylum Hemichordata – Class Graptoloidea

Description of the following fossils

Arthropoda:Paradoxides, Olinus, Olenellus, Calymene and Phacops

Hemichordata: Graptoloidea; Tetragraptus, Didymograptus, phyllograptus, Diplograptus, Monograptus and Rastrites.

	An outline of classification of plant kingdom. A brief description of the following plant fossils and their geological ranges; Glossopteris, Gangamopteris, Lepidodendron, Sigillaria, Elatocladus, Ptilophyllum and Vertebraria
Unit V	Principles of Stratigraphy – Geological time scale – laws of Stratigraphy – Imperfections in the geological record – An outline on stratigraphic classification: Litho, Bio, Chrono, Sequence and Magneto stratigraphy. Homotaxis – Facies and Facies changes, Walther's law of facies. Correlation: Definition and type. Physical and Biological criteria of correlation.

Reference and Text books:

Dunber, C.O. (1970). *Historical Geology*. United States: John Wiley & Sons.

Hendry Woods, (1958). *Paleontology- Invertebrate*. New Delhi: CBS Publishers and Distributors.

Jain, P.C., &Anantharaman, M.S. (2008). *An introduction to paleontology*. Delhi: Vishal Publication.

Jones, (1958). *Introduction to Microfossils*. New York: Harper & Brothers.

Krishnan, M.S. (1956). *The Geology of India and Burma*. Delhi: CBS Publishers & distributors.

Moore.,Lalicker., & Fischer, (1952). *Invertebrate Fossils*. Newyork: McGraw Hill.

Ravindra Kumar, (2015). *Fundamentals of Historical Geology and Stratigraphy*. Wiley Eastern Limited.

Rhona M, Black. (1972). The *Elements of Palaeontology*. Cambridge University Press.

Robert, L.C. (2018). *A concise Dictionary of Paleontology*. Springer Nature.

Shrock.,&Twenhofel, (1953). *Invertebrate Paleontology*. New York: McGraw Hill.

Stokes, W.L. (1982). Essential *of Earth's History*. Prentice Hall.

Von Zittel, (1913). A *Textbook of Paleontology*. London: McMillan and Coy Ltd.

Wadia, D.N. (1953). *Geology of India*. New Delhi: Tata McGraw Hill Publishing Company.

Wilson, J.W. (2021). *Investigating Fossils- A History of Paleontology*. Newyork: Wiley Blackwell.

Outcomes	The knowledge of Palaeontology would enable the students to understand the origin of life though ages in the history of the earth and relate them to their field observations.

Course code: 22BGE2P1	Semester II	T/P	C	H/W
	Core Practical – I PALAEONTOLOGY	P	4	4

Objectives	To impart to students, the hands-on skills of identifying and describing the invertebrate fossils
	Identification and description of the following fossils. **Protozoa:**Formanifera: Textularia, Globigeriana, Nummulites, Fusulina **Porifera**: Siphonia **Coelenterata : Corals** Zaphrentis, Cyathophyllum, Omphyma, Lithostrotion, Calceola, Montlivoltia, Isastrea, Thecosmilia, Heliolites, Favosites, Halysites. **Brachiopoda:** Lingula, Orthis, Productus, Pentamerus, Rhynoconella, Terebratula, Atrypa, Spirifer and Athyris. **Mollusca: Pelecypoda**: Arca, Glycimeris (Pectenculus) Inoceramus, Ostrea, Alectryonia, Pecten, Plicatula, Spondylus, Trigonia, Pholadomya, Cardita, Hippurites, Cardium, Venus, MeretrixGryphaea, Exogyra. **Gastropoda:** Bellerophon, Turbo, Goniatites, CeratitiesPhyiloceras, Acanthoceras, Scholenbachia, Scaphites, Perisphinctus, Hamites, Turrilites, Baculites, Belemininites. **Cephalopoda:** Orthoceras, Nautilus, Goniatites, Ceratites, Phylloceras, Lytoceras, Acanthoceras, Scholenbachia, Scaphites, Perisphinctus, Hamites, Turrilites, Baculites, Beleminites. **Arthropoda:**Trilobita; Paradoxides, Olinus, Ollenellus, Calymene, Phacops **Echinodermata** : **Crinoidea:**Encrinus, Marsupites **Blastoidea:**Pentremites **Echinoidea**: Cidaris, Hemicidaris, Stigmatopygus, Holaster, Hemiaster, Micraster. **Hemichordata:** Graptoloidea; Tetragraptus, Didymograptus, Phyllograptus, Diplograptus, Monograptus, Rastrites. **Plant fossils**: Calamites, Sphenophyllym, Lepidodendron, Sigillaria, Glossopteris, Gangamopteris, Ptilophyllum, Vertebraria, Elatocladus (Taxites).

Reference and Textbooks:

Moore.,Lalicker., & Fischer, (1952). *Invertebrate Fossils*. Newyork: McGraw Hill.

Shrock.,&Twenhofel, (1953). *Invertebrate Paleontology*. New York: McGraw Hill.

Subramani, K., &Manivannan, V. (2009). *Palaeontology Practical Manual*. Vishal Publishing Co

Outcomes	The students will acquire skills of identifying/ discovering and describing fossils and their taxonomic classification. They will also learn to interpret paleoenvironmental conditions.

Semester - III				
Course code: 22BGE3C1	**Core Course IV**	**T/P**	**C**	**H/W**
	Crystallography and Optical Mineralogy	**T**	**3**	**3**
Objectives	• To understand the nature and characteristics of crystals • To acquire knowledge on various crystal systems with special reference to their type minerals. • To understand the nature and properties of light. • To learn the optical properties of minerals using refractive light.			
Unit -I	**Crystallography:** Definition and scope. Crystalline and amorphous forms. A brief outline of crystal structure. Concept of unit cell, motif, lattice and its types, an outline on crystal projection. Morphological characters of a crystal. Elements of crystal symmetry – Crystallographic axis – Axial Ratios, Parameters Indices and Symbol. Weiss and Millerian systems of crystal notation – zones – crystal forms – interfacial angles and their measurements – Contact and Reflecting Goniometers. Classification of crystals into systems and classes. Holohedral, Hemihedral, Hemimorphic and enantiomorphous forms in crystals. Study of the symmetry elements and forms of the Normal, Pyritohedral, Tetradedraal and Plagiohedral classes of Cubic system with special reference to their type minerals			
Unit -II	Study of symmetry elements and forms of Normal, Hemimorphic, Tripyramidal, Pyramidal Hemimorphic, Sphenoidal and Trapezohedral classes of Tetragonal system with special reference to well-developed crystals of Zircon, Rutile, Cassiterite, VesuvianiteApophyllite, Scheelite, meonite, Wulfenite and Chalcopyrite. Study of the symmetry elements and forms of Normal, Hemimorphic, Tripyramidal, Pyramidal – Hemimorphic, Trapezohedral, Rhomohedral, Rhombohedral hemimorphic, and Trapezohedralclassess of Hexagonal system with special reference to well-developed crystals of Beryl, Zincite, Apatite, Calcite, Corundum, Tourmaline, Phenacite and Quartz.			
Unit -III	Study of Normal, Hemimorphic and sphenoidal classes of Orthorhombic system with special reference to well-developed crystals of Barite, Olivine, Topaz, Staurolite, sulphur, Calamine, and Epsomite. Study of the symmetry elements and forms of the Normal classes of Monoclinic and Triclinic systems with special reference to well-developed crystals of Gypsum, Orthoclase, Augite, Axinite, Albite. Twin crystals - Definition - Evidences of twinning - Twinning plane, twinning axis and composition plane, Laws of twinning, kinds of Twinning – Simple, Contact, Penetration and repeated. Polysynthetic and Cyclic twins. Secondary twins. Study of twin laws pertaining to the following crystals; Flourite, Pyrite, Rutile, Calcite, Quartz, Aragonite, Staurolite, Gypsum, Augite and Feldspars. A brief outline of imperfection and irregualriites in crystals.			
Unit -IV	**Optical Mineralogy**: Introduction to general characteristics of light – polarization, plane polarized light, Brewster's law, polarization by absorption – Isotropism and Anisotropism – double refraction. Nicol Prism – its construction and uses; polaroids. Petrological microscope – its parts and thier functions. Construction and use of the following optical accessories – Quartz wedge, Gypsum plate and Mica Plate.			
Unit -V	Isotropic minerals – properties observed under parallel nicols. Uniaxial minerals: Properties under parallel and crossed nicols – optic axis, determination of relative refractive index, optic sign and sign of elongation – dichroism. Biaxial minerals properties observed under parallel and crossed nicols – optic axes optic normal, 2v, optic axial plane, optic sign, birefringence- pleochrosism, extinction, extinction angle and its determination, A brief outline about interference colour, the order of interference colors ,quartz wedge, colour chart and its applications.			

References and Textbooks:

Dana, E.S. (1949). *A text book of Mineralogy*. Asia Publishing House.

Phillips, P.C. (1963). *An introduction to Crystallography*. Longmans Green & Co.

Read, H.H. (1962), (2005). *Elements of Mineralogy27thedition.,*W.H. Freeman & Co.

Wade, F.A & Mattox, R.B (1960). *Elements of Crystallography and Mineralogy*. Harper & Bros.

Smith, H.G (1968). *Minerals and microscopes*. Allied publishers PVT. Ltd.

Naidu, P.R.J. (1967). *Johannsen's Optical Mineralogy*. Allied Publishers PVT.Ltd.

Paul F. Kerr (1957). *Optical Mineralogy*. McGraw Hills.

Winchel, A.M. (1946). *Optical MineralogyPart 1&2.* John Wiley.

Philips, (1954). *Mineral Optics*. Freeman and Co.

Donald Bloss, F. (1960). *Optical crystallography*. Holt Rinehart and Winston, New York.

Sharma R.S. & Sharma, A (2013) *Crystallography and Mineralogy – Concepts and methods.* Geological Society of India Publication, Bangalore.

Outcomes	Students will obtain a comprehensive idea on the system of crystallization and its significance in the classification of mineral kingdom; Different properties of minerals in relation to their behavior with the refracting light.

Semester - III				
Course Code	**Core Course V**	**T/P**	**C**	**H/W**
22BGE3C2	**MINERALOGY**	**T**	**3**	**3**

Objectives	To impart knowledge on • General characteristics and common physical properties of minerals • Physical and optical properties, chemical composition and mode of occurrence specific to various mineral groups.
Unit -I	Definition and scope – general characteristics of minerals – mode of occurrence and association of minerals – physical properties of minerals and their determination. Definition, explanation and examples of the following: Isomorphism. Dimorphism, Polymorphism, Isodimorphism, Paramorphism, Pseudomorphism – Molecular and empirical formulae of minerals.
Unit -II	A brief account on silicate structures. Physical and optical properties, chemical composition and mode of occurrence of the minerals of Quartz group, Feldspar group and Feldspathoid group
Unit -III	Physical and optical properties, chemical composition and mode of occurrence of the following mineral groups - Pyroxene, Amphibole and Garnet.
Unit -IV	Physical and optical properties, chemical composition and mode of occurrence of the minerals of Mica, Zeolite Scapolite, Wollastonite, Rhodonite groups
Unit -V	Physical and optical properties, chemical composition and mode of occurrence of the following mineral groups Olivine, Epidote, Beryl, Apatite, Cordierite, Staurolite, Tourmaline, Topaz, Zircon, Sphene, Chlorite, Serpentine, Andalusite, Kyanite, Sillimanite, Talc, Kaolin, Fluorite, Calcite, Dolomite, Magnesite and Rutile

Reference and Textbooks:

Berry, L.G. Brain Mason, Dietrich, R.V. (2004). *Mineralogy*, 2nd ed., CBS Publishers &Distributors.

Dana, E.B. (2006). *A Text book of Mineralogy*, 4th ed., Wiley Eastern Ltd.

Dexter Perkins, (2003). *Mineralogy 3rd ed.*Publisher: Prentice-Hall New Arrivals.

Read, H.H. (2005). *Rutley's Elements of Mineralogy*, 27th ed., Murby and Co.

Richard Kirwan, (2002). *Elements of Mineralogy (Paperback)*, Hard press Publishing.

William D. Nesse, (2000). *Introduction to Mineralogy (Paperback),* Oxford University Press.

Outcomes	Students will be able to appreciate a set of varied properties of minerals with respect to their groups.

Semester - III				
Course code: 22BGE3P1	**Core Practical II**	**T/P**	**C**	**H/W**
	CRYSTALLOGRAPHY	**P**	**3**	**3**

Objectives

To describe

- The axial characters, symmetry elements and forms present in the crystals of various systems.
- The twin axis, twin plane, type of twinning and twin laws in twinned crystals.

Crystallography:

Morphological study of the crystal models representing the following minerals;

Cubic system:

Normal Class: Galena, Garnet, Gold, Fluorite, Copper, Magnetite
Pyritohedral Class: Pyrite
Tetrahedral Class: Tetrahedrite, Sphalerite, Boracite.
Plagiohedral Class: Cuprite

Tetragonal System:

Normal Class: Zircon, Rutile, Vesuvianite , Cassiterite, Apophyllite
Tripyramidal Class: Scheelite, Scapolite
Pyramidal – Hemimorphic Class: Wulfenite
Sphenoidal Class: Chalocopyrite
Trapezohdral Class: Nickel Sulphate

Hexagonal System:

Normal Class:Beryl
Hemimorphic Class: Zincite
Tripyramidal Class: Apatite
Hexagonal Trapezohedral Class: Quartz
Rhombohdral Class: Calcite, Haematite, Corundum
Rhombohdral – Hemimorphic Class: Tourmaline
TrigonalTrapezoheral Class: Quartz

Orthorhombic system

Normal class: Barite, Sulphur, Olivine, Topaz
Staurolite, Hypersthene
Hemimorphic Class: Calamine
Sphenoidal Class: Epsomite

Monoclinic System

Normal Class: Gypsum, Augite, Hornblende, Epidote, Orthoclase

Triclinic system

Normal class: Axinite, Albite, Anorthite, Rhodonite.

Twin Crystal of the minerals: Spinel, Fluorite, Pyrite, Rutile, Calcite, Staurolite, Aragonite, Calamine, Gypsum, Orthoclase, Augite, Hornblende, Albite.

Reference and Text Books:

Battey, M.H. (1964). *Mineralogy for Students*, Longmans.

Berry, Mason &Deitrich. (2004). *Mineralogy*, 2nd ed., CBS Publishers &Distributors.

Dana, E.B. (2006). *A Text book of Mineralogy*, 4th ed., Wiley Eastern Ltd.

Dexter Perkins (2003). *Mineralogy,* 3rd ed.,Publisher, Prentice- Hall New Arrivals.

Rabindra Nath Hota, (2017). *Practical Approach to Crystallography and Mineralogy,* 2nd ed., CBS Publishers &Distributors.

Read, H.H. (2005). *Rutley's Elements of Mineralogy*, 27th ed., Murby and Co.

Outcomes	Students will be able to locate the position of crystal axis; describe the axial character, symmetry elements and forms present in each crystal.

Semester - IV				
Course code: 22BGE4C1	**Core Course VI**	**T/P**	**C**	**H/W**
	INDIAN STRATIGRAPHY	**T**	**4**	**4**
Objectives	• To understand the Indian sub-continent and its divisions • To study the major stratigraphic formations of India			
Unit -I	Physiographic division of India – a comparative study of physiograpic divisions – major stratigraphic formations of India. General characteristics and descriptive study with a note on the economic importance of the Archaean and Dharwar rocks of the peninsular India.			
Unit -II	General characteristics and descriptive study with a note on the economic importance of the Cuddapah and Vindhyan systems and their equivalents in the Peninsular India.			
Unit -III	General characteristics and descriptive study of the following stratigraphic formations. Cambrian of salt range – Age of saline series, Haimanta system of Spiti and Kashmir – Permocarboniferous, Triassic and Jurassic systems of Kashmir and Spiti – Umaia marine beds.			
Unit -IV	Gondwana super group – divisions, structure, climate and conditions of sedimentation, General characteristics & descriptive study of the different divisions of marine Mesozoic rocks of Peninsular India – Jurassic of Kutch and Cretaceous rocks of Trichinopoly.			
Unit -V	Deccan trap and their age – Inter trappeans and Intra trappeans. Rise of Himalayas, Eocene of Assam, Oligocene and Miocene of Assam, Cuddalore sandstone, Rajahmundry sandstone, Warkala beds, Quilon beds. Conditions of deposition and faunal content of Siwalik system – Karewa Series.			

Reference and Textbooks:

Krishnan, M.S. (1956). *Geology of India and Burma*. C.B.S. Publishers

Ravindra Kumar. (2015). *Fundamentals of Historical Geology and Stratigraphy of India*. Wiley Eastern Ltd., New Delhi.

Wadia, D.N. (1953). *Geology of India*. McMillan.

Stokes, W.L. (1960). *Essentials of Earth History*. Prentice Hall.

Dunber C.O. (1960). *Historical Geology*. John Wiley & Sons.

Wadia, D.N (1919). *Geology of India for students*. Macmillan and Co. London.

Ramakrishnan, M & Vaidyanadhan, R. (2008 &2010). *Geology of India (Vol. 1 & 2).* Geological society of India Publication, Bangalore.

Outcomes	Students will possess a complete knowledge of the Geology of Indian subcontinent; distribution of various rock types, their fauna and flora and economic mineral resources.

Semester –IV				
Course code 22BGE4C2	**Core Course VII**	**T/P**	**C**	**H/W**
	STRUCTURAL GEOLOGY	**T**	**4**	**4**

Objectives	➢ To know the methods of geological mapping. ➢ To study the mechanical and deformation; characteristics of rocks that lead to formation of various structures ➢ To study different types of structures and their classification.
Unit -I	Methods of representing physiographic features, topographic maps, preparation and uses of geologic maps. Attitude of planes – strike and dip of the formation – trends of outcrops and rule of 'V' Relation between true and apparent dips – width of outcrops – true and vertical thickness.
Unit -II	Definition of stress and strain, compressive and tensile stresses, shearing stress, couple, three stages of deformation. Folds: Geometry and classification of folds. Description of single folds - descriptive study of fold system - Description of folds as seen in the profile - criteria for recognition of folds in field and map.
Unit -III	Fault: Fault terminology – Geometrical and genetic classification of faults – Criteria for recognition of faults.
Unit -IV	Joints: Joint sets and systems – joint surface - relations of joints to other structures - geometric and genetic classifications. Repetition of outcrops due to erosion, folding and faulting. Inliers and outliers - Nappe – Klippe and Fenster.
Unit -V	Unconformities: General Characteristics - Kinds of Unconformities - Criteria for recognition – overlap and off lap. Criteria to distinguish unconformities from faults. Brunton Compass & Clinometer Compass – Parts and their functions.

Reference and Text books:

Billings, M.P. (2016). *Structural Geology, 3rd Edition*, Pearson Education, India.

Hobbs, Bruce, E. Means, W.D. and Williams, P.F. (1976). *An outline of structural geology*, John Wiley & Son, New York.

Lahee, F.H, (2002). *Field Geology 6th ed*., McGraw Hill Book company Inc., New York.

Himus, and Sweeting, (1951). *The elements of Field Geology*, University Tutorial Press Ltd, London.

Ghosh, S.K. (1995). *Structural Geology Fundamentals Modern Developments*, Pergamon press, London.

Hills, E.S. (1965). *Elements of Structural Geology, 2nd Ed*. John Wiley, New York.

Badgley, P.C. (1965). *Structure and Tectonic principles*, Harper and Row, New York.

Gokhale, N.W. (2006). A *manual of problem in structural Geology*, CBS publishers & Distributions, New Delhi.

John Suppe, (1985). *Principles of Structural Geology*, Prentice Hall publications, New Delhi.

Davis, G.R. (1984). *Structural Geology of Rocks and Region*, John Wiley & Sons, New Jersey.

Ramsay, J.G. and Huber, M.I. (1987). *Modern structural Geology Vol- I and II*, Academic press, Cambridge, London.

Price N.J. and Cosgrove, J.W. (1990). *Analysis of Geological structures*, Cambridge Univ. Press, London

Robert R. Compton, (1962). *Manual of field geology*, John Wiley and sons, New Jersey.

Jain, A.K. (2014). *An Introduction to Structural Geology*, Geological Society of India, India.

Outcomes	Learners will understand various mechanisms for the formation of structures, types and their forms of topographic expressions.

Semester - IV				
Course Code	**Core Practical III**	**T/P**	**C**	**H/W**
22BGE4P1	**Mineralogy**	**P**	**3**	**3**

Objectives	• To train students on the identification of minerals of various groups both in hand specimen and under microscope.
	Silica Group **Quartz and its macro crystalline varieties**: Rock crystal, Milky, Amethyst, Rose, Smoky, Sagenite, (Quartz with Tourmaline needles) and Cat's eye (Chrysoberyl) **Cryptocrystalline varieties**: Chalcedony, Plasma, Bloodstone, Agate, Moss agate, Silicified wood, Flint, Chert, Jasper, Tiger eye, Opal-wood and milky varieties.
	Feldspar Group: Sanidine, Microcline, Amazonstone, Orthoclase, Moonstone and Perthite. Plagioclase Feldspars – AlbiteOligoclase and Labradorite. **Felspathoid Group:**Leucite, Nepheline and Sodalite **Clay Mineral:** Kaolin
	Amphibole Group: Anthophyllite, Tremolite, Actinolite, Hornblende, Glaucophane and Riebeckite. **Pyroxene Group**: Enstatite, Bronite, Hypersthene, Diopside, Augite and Spodumene. **Pyroxenoid Group:**Rhodonite and Wollastonite. **Mica group**: Muscovite, Phlogophite, Biotite and Lepidolite.
	Zeolite group: Stilbite, Heulandite, Natrolite, Analcime, Chabazite and Apophyllite. **Aluminium Silicate Group**: Anadalusite, Silimanite, Kyanite, Staurolite, Topaz and Tourmaline.
	Other minerals: Beryl, Cordierite, Zoisite, Epidote, Olivine, Garnet, Zircon, Titanite, Apophyllite, Talc, Chlorite, Calcite, Apatite and Corundum

Reference and Textbooks:

Dana, E.B. (2006). *A Text book of Mineralogy*, 4th ed., Wiley Eastern Ltd.

Read, H.H. (2005). *Rutley's Elements of Mineralogy*, 27th ed., Murby and Co.

Berry, L.G. Brain Mason, Dietrich, R.V. (2004). *Mineralogy*, 2nd ed., CBS Publishers & Distributors.

Dexter Perkins, (2003). *Mineralogy 3rd ed*.,Publisher: Prentice-Hall New Arrivals.

William D. Nesse. (2000). *Introduction to Mineralogy (Paperback),* Oxford University Press.

Richard Kirwan (2002). *Elements of Mineralogy (Paperback),* Hard press Publishing.

Outcomes	Learners will be able to distinguish minerals of different groups based on their physical and optical properties.

Semester - V				
Course code: 22BGE5C1	**Core Course VIII**	**T/P**	**C**	**H/W**
	Igneous Petrology	**T**	**4**	**4**

Objectives	To impart knowledge on • The forms, textures, structures and classification of igneous rocks • Types of magma and their properties, crystallization of unitary and binary systems • Petrographic characters of Granite, Syenite, Diorite, Gabbro and their volcanic equivalents
Unit -I	Nature and scope of petrology – the earth shells and the chemical composition of the earth. General classification of the rocks into and a comparative study of the characteristics of igneous, sedimentary and metamorphic rocks. Magma composition and constitution of mamas; primary magmas. Forms of igneous rocks, extrusive forms – lava flows and pyroclastic deposits, intrusive forms – concordant and discordant forms
Unit -II	Structure and texture of igneous rocks. Structures – vesicular amygdaloidal, block lava, Ropy lava, pillow structure, flow structure, sheet joints, mural joints and columnar joints, rift and grain. Textures – definition, elements of texture, kinds of textures – equigranular, inequigranular, directive, intergrowth, reaction, xenolithic and others.
Unit -III	Silicate systems and igneous petrogenesis; Crystallization of unicomponent magma, Binary magma with simple euetectic (Diopside- Anorthite system), with solid solution (Albite-Anorthite system), and with incongruent melting (Forstrite - Silica system). Bowen's reaction principle and its bearing on igneous petrogenesis. Diversity of igneous rocks in space and time – evidences and theories of differentiation. Assimilation. Elementary treatment of variation diagrams and petrographic provinces.
Unit -IV	Principles and parameters in the classification of igneous rocks – megascopic classification, Shands saturation principles. Outlines of classification of C.I.P.W and Tabular Classificaiton of Tyrrel
Unit -V	Petrographic characteristics of Granite, Granodiorite, Syenite, Diorite, Gabbro, and their Hypabyssal and Volcanic equivalents, petrographic characters, and origin (brief account) of Pegmatities and Aplites, Lamprophyres, Alkaline rocks, Ultrabasic rocks and Anorthosites.

Reference and Textbooks:

Barth, F.W. (1956). *Theoretical Petrology*. Wilez.

Bowen, N.L. (1956). *The evolution of Igneous rocks*. Dover publications.

Ernest G, Ehlers.& Harbey Blatt, (1999). *Petrology: Igneous, Sedimentary & Metamorphic*. CBS Publishers & Distributors, New Delhi.

Gautam Sen, (2014). *Petrology. Principles and Practice*. Springer.

Hatch, F.H., Wells, A.K., & Wells, M.K. (1949). *Petrology of Igneous rocks*, Thomas Murby.

Huang, W.T. (1962). *Petrography.* McGraw Hill.

Johannsen, A. (1962). *Descriptive Petrology of Igneous rocks*. Allied Pacific.

Myron, G. Best. (1986). *Igneous and Metamorphic Petrology*. New Delhi: CBS Publishers & Distributors.

Ronald Frost, B., & Carol Frost, D. (2019). *Essentials of Igneous and Metamorphic Petrology*. Cambridge University Press.

Shand, S.H.J. (1990). *Eruptive Rocks*. John Wiley & Sons.

Turner, F.J., &Verhoogen, J. (1951). *Igneous and Metamorphic Petrology*, McGraw Hill.

Tyrrell, G.W. (1970). *The Principles of Petrology*. Methuen & Co.

Williams, H., Turner, F.J., & Gilbert, C.M. (1969). *Petrography.* W.H.Freeman& Co.

Outcomes	Students would acquire a comprehensive knowledge on various forms, textures and structures of igneous rocks; will be able to understand the crystallization behavior of magmas; will know the petrographic characters of igneous rocks and their classification.

Semester – V				
Course Code	**Core Course IX**	**T/P**	**C**	**H/W**
22BGE5C2	**Sedimentary and Metamorphic Petrology**	**T**	**4**	**4**

Objectives	• To understand the processes of sedimentation; texture, structure and classification of sedimentary rocks. • To study the metamorphism, its processes and types.
Unit -I	**Sedimentary Petrology**: Sedimentary process – disintegration and decomposition of rocks – transportation deposition – diagenesis – a broad outline of classification of sedimentary rocks into residual, mechanical, chemical and organic groups – clastic and non-clastic textures of sedimentary rocks - mechanical, chemical and organic structures of sedimentary rocks
Unit -II	Residual deposits – clay, laterite, terrarosa and soils, their mode of formation. Characteristics of important types of clastic deposits: Rudaceous, Arenaceous and Argilaceous groups, their classification, mineral composition and texture – Descriptive study of Conglomerate, Breccia, Sandstone and Shale
Unit -III	Chemical deposits: siliceous, calcareous, ferruginous and organic and salt deposits. Organic deposits: calcareous, siliceous, phosphatic, ferruginous and carbonaceous origin. A brief study of flint, chert, siderite, gypsum, rock salt, caliche and guano.
Unit -IV	**Metamorphic Petrology:** Definition, agents and kinds of metamorphism – facies, grades and zones of metamorphism – metamorphic textures and structures – A short account on anatexis and palingenesis – cataclastic metamorphism and its products – Thermal metamorphism and its products
Unit -V	Dynamo thermal metamorphism and its products – Plutonic metamorphism and its products – Metasomatism and metasomatic processes: Pneumatolyitc metamorphism – Injection metamorphism and Auto metamorphism. Petrographic description of quartzite, slate, schist, gneiss, marble, hornfels, migmatite and charnockite

Reference and Textbooks:

Anthony Philpotts, R. (1990). Principles *of igneous and metamorphic petrology*, Prentice Hall Publication.

Bahaskara Rao, B. (1986). *Metamorphic Petrology*— Oxford & IBH Publishing Company Pvt. Ltd.

Blatt, H. (1972). *Origin of sedimentary rocks*, Prentice Hall Publication

Green smith, (1971). *Petrology of the sedimentary rocks*, C.B.S Publishers and Distributors, Delhi.

Harker, (1979). *Petrology for students*, Cambridge University Press.

Huang, W.T. *Petrology*, McGraw Hill Book Company.

Jackson, K.C. (1970). *Text book of lithology*, McGraw Hill Publication.

Myron, G. Best, (2003). *Igneous and Metamorphic Petrology*, C.B.S Publication.

Nockolds, S.R. Knox, R.W.O.B. and Chinner, G.A. (1979). *Petrology for students*, Cambridge University Press.

Pettijohn, F.J. (2004). *Sedimentary Rocks*, Harper and Row Publication

Pirsson, L. V. and. Knopf A (1926). *Rocks and minerals*, John Wiley & Sons, New York.

Roger Mason, (1984). *Petrology of the Metamorphic rocks*, C.B.S Publishers & Distributors, Delhi.

Sengupta, S.M. (1994) & (2007). *Introduction to Sedimentology*, CBS Publishers & Distributors, New Delhi.

Turner, F.J. and Verhoogen, J. (2004). *Igneous and Metamorphic petrology* — C.B.S. Publishers and Distributors, Delhi.

Tyrrell, G.W. (2013). *The principles of petrology*, C.G.S. publishers and Distributors, Delhi.

William, H. Turner, F.J. and Gillbert, C.M, (1954). Petrography, Freeman and Company.

Winkler, H.G.F. (1976). *Petrogenesis of metamorphic rocks*, Narosa Publishing House, New Delhi.

Outcomes	Students would have an inclusive understanding of different processes involved in the formation of sedimentary and metamorphic rocks; their textures, structures and types.

Semester - V				
Course Code	**Core Course X**	**T/P**	**C**	**H/W**
22BGE5C3	**Economic Geology**	**T**	**4**	**4**

Objectives	• To gain knowledge on different processes of mineral formation • To understand the classification of mineral deposits • To study the important ores; their occurrence; uses and distribution in India. • To know the origin, occurrence and Indian distribution of coal and petroleum.
Unit -I	An outline of the processes of formation of mineral deposits. Magmatic, sublimation, contact metasomatic, hydrothermal, residual, placer, oxidation and supergene sulphide enrichment, evaporation and metamorphism. Banded iron ore formation. Origin of phosphatic deposits.
Unit -II	Controls of ore localization, metallogenic epochs and provinces, geologic thermometers, classification of ore deposits – Lindgrens and Batman's classification
Unit -III	Composition, mode of occurrence, uses and distribution in India of an important ores: Aluminium, Gold, Silver, copper, Lead, Zinc, Iron, Manganese, Chromium, Titanium, Uranium, Thorium, Beryllium, Zirconium and Lithium.
Unit -IV	Qualities, mode of occurrence and distribution in India of the raw material required for the following industries/refractories: Abrasive, Ceramic, Glass, Cement, Paint and Pigment, and Fertilizer. Building stones and gemstones – quality, mode of occurrence and distribution in India.
Unit -V	Fossil fuel: Coal - Origin, classification, occurrence and distribution in India. Petroleum - Origin, occurrence and distribution in India.

Reference and Textbooks:

Bateman, A.M. (2012). Economic *Mineral Deposits,* John Wiley & Sons.

Chapman, R.E. (1989). *Petroleum Geology,* Elsevier.

Deb, L. (1980). *Industrial Minerals and Rocks*, Allied Publishers Pvt. Ltd.

Gokhale and Rao, T.C. (1978). *Ore deposits of India*, Thomson 2nd ed. Faridabad.

Krishnaswamy, S. (1979). *India's Mineral Resources,* Oxford IBH Publishing Co.

Lindgren, (1933). *Mineral deposits*, McGraw Hill.

Sharma, M.L. and Ram, K.V.S. (1964). *India's Economic Minerals*, Dhanbad.

Smirnov, V.I (1976). *Geology of Mineral deposits*, Mir. Publishers, Moscow.

Tissot, B. and Welte, DH. (1984). D.H. *Petroleum formation and occurrence,* Springer.

Wadia, D.N. (1953). *Geology of India London*, Macmillan; New York: St Martin's Press.

Outcomes	Students would have a complete understanding on different processes of mineral formation; various mineral deposits and their classification; mode of occurrence, uses and Indian distribution of important ores; origin, occurrence and Indian distribution of coal and petroleum.

Semester – V				
Course Code: 22BGE5C4	**Core Course XI**	**T/P**	**C**	**H/W**
	Field Geology	**T**	**4**	**4**

Objectives	• To make the students realize the importance of field work; read the topographic map. • To give a generalized idea about different geological mapping and sampling techniques • Brief the students the different techniques
Unit -I	Importance of field geology – tasks of field geologist – preparation for and planning of field trip-field equipments – places of importance for the field geologist – where to look for outcrops, fossils and other geological features.
Unit -II	Topographic features, methods of representing topography on maps – Clinometer compass and Brunton Compass, their uses - detailed study of contouring, dip, true dip and apparent dip, their relationship with strike. Influence of dip and ground slope on outcrops.
Unit -III	True thickness and vertical thickness of beds, their measurement in the field, relationships between true thickness and vertical thickness, their calculation from field data. Conditions that bring about repetition of outcrops.
Unit -IV	Sampling – definition of a sample – sample requirement as to the size, purity, contamination, packing etc. Important methods of sampling: Chip samples, muck samples, car samples, channel samples, grit samples, pitting and trenching the ore bodies, drill hole sampling or core sampling. Coning and quartering.
Unit -V	Topographic map – details printed on the map, cardinal points (directions) conventional signs, scale of map, map references (indexing), orienting the map, locating the position of outcrops on a map, plotting attitude of beds, symbols used for rock types and various structural features – an outline on preparation of geological map and report.

Reference and Text books:

Billings, M. P. (2016). *Structural Geology 3rd edition*. Prentice – Hall of India Pvt Ltd.

Chiplonker, G. W. (1960). *Geological Maps.* Dastane Bros., Pune.

Compton, R. R. (1962). *Field Geology*. Wiley Publishers.

Foresten, J. D. (1940). *Principles of field and mining geology.* Wiley Publishers.

Geikie, J. (1952). *Structural and Field Geology*. Oliver and Boyd Publishers.

Gokhale, N. W. (2017). *Manual of Geological Maps.* CBS Publishers and Distributors.

Himus, G.W., & Sweeting, G. S. (1972). *Elements of field geology.* University Tutorial Press.

Jain, A.K. (2014). *An introduction to structural Geology*. Geological Survey of India.

Lahee, F. H. (2002). *Field geology, 6th ed*. McGraw Hill, Publishers.

Low, J. W. (1957). *Geological field methods*. Harper & Brothers publishers.

Mikhailar, A. Ye. (1987). *Structural geology and geological mapping.* Mir Publishers.

Thomas, J. A. G. (1980). *Interpretation to Geological maps.* Murby Publishers.

Upton, W. B. (1986). *Landforms and topographic maps.* John Wiley Publishers.

Outcomes	Leaners would appreciate the importance of geological field work; acquire a skill to conduct a geological field work by the effective handling of field gears viz. toposheet, brunton and clinometer compass, etc. and to collect field samples adopting standard techniques.

Semester - V				
Course code: 22BGE5P1	**Core Practical - IV**	**T/P**	**C**	**H/W**
	Petrology	**P**	**4**	**6**

Objectives

To impart practical knowledge on the identification of igneous, sedimentary and metamorphic rocks in hand specimen and in microsection.

Megascopic identification and description of the following rocks in hand specimen:

Igneous Rocks: Mica Granite, Hornblende Granite, Pyroxene Granite, Tourmaline Granite, Graphic Granite, Pegmatite, Aplite, Mica Syenite, Hornblende Syenite, Pyroxene Syenite, NephelineSyenite, Diorite, Gabbro, Norite, Dunite, Pyroxenite, Peridotite, Anorthosite, Dolerite, Dolerite Porphyry, Rhyolite, Trachyte, Andesite, Felsite, Basalt, Obsidian Pitchstone, Pumice, Volcanic Tuff, Volcanic breccias and Vitrophyre.

Sedimentary Rocks: Conglomerate, Breccia, Sandstone, Arkose, Grit, Flagstone shale, Laterite, Limestone, Clay, Chalk, Flint, Chert, Phosphatic Nodule, Peat, Lignite, Bituminous Coal and Anthracite.

Metamorphic Rocks: Mica gneiss, Hornblende schist, Chlorite Schist, Chlorite mica schist, Chlorite garnet schist, Mica garnet schist, Mica staurolite schist, Talc schist, Graphite Schist, Phyllite, shale, slate, Quarzite, Marble, Dolomite, Quartz magnetite rock, Amphibolite, Eclogite, Khondalite, Gondite, Charnockite and Calc granulite.

Microscopic identification and description of the following rocks in thin section:

Igneous Rocks: Muscovite-Biotite Granite, Hornblende granite, Alkali granite, Tourmaline granite, Pegmatite, Aplite, Hornblende syenite, Pyroxene syenite, Nephelinesyenite, Mica syenite, Quartz diorite, Gabbro, Olivine – gabbro, Norite, Dunite, Peridotite, Pyroxenite, Granite Porphyry, Syenite Porphyry, Diorite porphyry, Dolerite, Rhyolite, Trachyte, Phonolite, Andesite, Basalt, Olivine Basalt, Obsidian and Pitchstone.

Sedimentary Rocks: Conglomerate, Breccia, Sandstone, Arkose, Grit, Shale, Laterite, Limestone, Oolitic limestone, Shell limestone, Clay, Chalk, Flint, Chert and Coal.

Metamorphic Rocks: Mica schist, chlorite schist, hornblende schist, staurolite schist, Actinolite Schist, Tremolite schist, garnetiferous mica schist, chiastolite slate, mica gneiss, pyroxene gneiss, charnockite, marble, eclogite, amphibolite, khondalite and cordierite sillimanite gneiss.

Reference and Textbooks:

Barth, F.W. (1956). *Theoretical Petrology*. Wilez.

Bowen, N.L. (1956). *The evolution of Igneous rock*s. Dover publications.

Ernest G, Ehlers. & Harvey Blatt, (1999). *Petrology: Igneous, Sedimentary & Metamorphic*. New Delhi: CBS Publishers & Distributors.

Gautam Sen, (2014). *Petrology. Principles and Practi*ce. Springer.

Hatch, F.H., Wells, A.K., & Wells, M.K. (1949). *Petrology of Igneous rocks.* Thomas Murby.

Huang, W.T. (1962). *Petrography*. McGraw Hill.

Johannsen, A. (1962). *Descriptive Petrology of Igneous rocks*. Allied Pacific.

Myron, G. Best. (1986). *Igneous and Metamorphic Petro*logy. New Delhi:

<table>
<tr><td colspan="2">CBS Publishers & Distributors.
Ronald Frost, B., & Carol Frost, D. (2019). Essentials of Igneous and Metamorphic Petrology. Cambridge University Press.
Shand, S.H.J. (1990). Eruptive Rocks. John Wiley & Sons.
Turner, F.J., &Verhoogen, J. (1951). Igneous and Metamorphic Petrology. McGraw Hill.
Tyrrell, G.W. (1970). The Principles of Petrology. Methuen & Co.
Williams, H., Turner, F.J., & Gilbert, C.M. (1969). Petrography. W.H. Freeman & Co.</td></tr>
<tr><td>Outcomes</td><td>Students would have acquired a hands on training on the identification of all three types of rocks both in hand specimen and under microscope.</td></tr>
</table>

Semester – V				
Course Code: 22BGE5P2	**Core Practical - V**	**T/P**	**C**	**H/W**
	Structural Geology, Field Geology and Economic Geology	**P**	**4**	**6**

Objectives

- To teach about contour maps and their interpretation.
- To predict the trends of the outcrop with respect to topography
- To decipher dip and strike of the outcrops
- To construct a geological map and cross section
- To find out the vertical thickness of formations.

Structural Geology

Map Exercises: Tracing of outcrops, three-point problems, measurement of dip and strike, bore hole problems, drawing simple sections and interpretation of geological maps.

Field Geology*

Every student has to undertake a field work every year under the guidance of Faculty members. Field work includes study of geology in the natural set up, collection of samples/specimens and preparation of a geological report. Specimens collected and the report prepared should be submitted for an assessment during university practical examination. Duration of the field trip for 1st, 2nd and final year shall not be more than 5, 7 and 15 days, respectively.

Economic Geology

Identification and description of the following economic minerals

Haematite, Magnetite, Limonite, Pyrolusite, Psilomelane, Chromite, Ilmenite, Rutile, Wulframite, Bauxite, Cuprite, Pyrite, Pyrrhotite, Marcasite, Chalcopyrite, Chalcocite, Bornite, Galena, Reaglar, Orphiment, Stibnite, Molybdenite, Cinnabar, Sphalerite, Franklinite, Samarskite, Monazite, Pitchblende, Barite, Celestite, Gypsum, Anhydrite, Rhodochrosite, Magnesite, Calcite, Dolomite, Malachite, Azurite, Cerussite, Siderite, Skmithsonite, Stontianite, Witherite, Phosphatic Nodule, Apatite, Asbestos, Graphite, Sillimanite, Kyanite, Corundum, Yellow ochre, Red ochre.

*** Twenty five percent of the marks will be allotted for field work**

Reference and Text books:

Billings, M. P. (2016). *Structural Geology 3rd edition*. Prentice – Hall of India Pvt. Ltd.

Chiplonker, G. W. (1960). *Geological Maps.*Dastane Bros., Pune.

Compton, R. R. (1962). *Field Geology*. Wiley Publishers.

Foresten, J. D. (1940). *Principles of field and mining geology.* Wiley Publishers.

Geikie, J. (1952). *Structural and Field Geology*. Oliver and Boyd Publishers.

Gokhale, N. W. (2017). *Manual of Geological Maps.* CBS Publishers and Distributors.

Himus, G.W., & Sweeting, G. S. (1972). *Elements of field geology.* University Tutorial Press.

Jain, A.K. (2014). *An introduction to structural Geology*. Geological Survey of India.

Lahee, F. H. (2002). *Field geology, 6th ed*. McGraw Hill, Publishers.

Low, J. W. (1957). *Geological field methods*. Harper & Brothers publishers.

Mikhailar, A. Ye. (1987). *Structural geology and geological mapping.* Mir Publishers.

Thomas, J. A. G. (1980). *Interpretation to Geological maps.*Murby Publishers.

Upton, W. B. (1986). *Landforms and topographic maps.* John Wiley Publishers.

Outcomes	Students will be able to understand the relationship between the contours and the topography; predict the trends and attitude of the outcrops; construct a geological map, cross sections along the given points and to find out the vertical

Semester - VI				
Course code: 22BGE6E1	**DSE-I**	**T/P**	**C**	**H/W**
	Regional Geology	**T**	**6**	**6**

Objectives	To impart knowledge on • Structure and Tectonics of Tamilnadu • Geology, structure, faunal content and economic importance of geological formations spanning age from Archean to Quaternary in Tamilnadu
Unit -I	Structure and tectonics, Shear zones, folds, faults and lineaments in Tamil Nadu. Rivers and Soil types of Tamil Nadu. The Western and Eastern Ghats of Tamil Nadu and their structural aspects. **Archaean and Proterozoic I**: An outline of Sathyamangalam group of central and NW Tamil Nadu.
Unit -II	**Archaean and Proterozoic II**: An outline of anorthosites of Sittampoondi, Kadavur and Oddanchatram, Peninsular gnessic complex (Bhavani group), Kolar group, Khondalite group with emphasis on Cordierite-sillimanite rocks of Trichy and Madurai regions, Charnockite group with emphasis on charnockites of Pallavaram, Migmatite complex, Alkaline complexes, Alkali syenite and cabonatite complexes, Granites of central and southern Tamil Nadu.
Unit -III	**Palaeozoic sediments**: An outline of Talchir formation of Palar basin. **Mesozoic sediments** – An outline of Upper Gondwana rocks of Terani and Uttattur, Sivaganaga formation, Sriperumputhur formation and Satyavedu formation and Avadi formation. An outline on marine Cretaceous formations of Trichirapalli, Virudhachalam and Pondicherry sub-basins.
Unit -IV	**Tertiary sediments**: An outline on Niniyur formation, Cuddalore Sandstone. Neyveli formation. Panamparai sandstone. **Quaternary sediments**: An outline on Pliocene rocks of Kambam valley, Conjeevaram gravels, Pliestocene rocks along the coastal tracts of Tuticorin district and laterite deposits of Eocene (shevroy, Kollimalai, Anaimalai, Nilgiri, Palani and Kodaikanal) and Mio-Plicene (Pudukkottai, Ramanathapuram and Cuddalore). An outline on Teri sands of Ramanathapuram, Tuticorin and Tirunelveli, Sand dunes of Kambam valley, Coromandal formation and Silica sands of Marakkanam
Unit -V	Descriptive study related to origin, mode of occurrence and use of iron ores of Kanjamalai and Kavuthimalai, Chromite and PGE of Sittampoondi, Magnesite deposits of Chalk hills, Bauxite deposits of Shevroy hills, Graphite beds of Sivaganga, Lignite deposits of Neyveli and Jayamkondam, Beach placer deposits of southern Tamil Nadu. Mode of occurrence and distribution of precious and semi-precious stones in Tamil Nadu

Reference and Textbooks:

Aiyengar, N.K.N. (1964). *Minerals of Madras State*. Madras: Dept. of Industries & Commerce.

Deb, L. (1980). *Industrial Minerals and Rocks*. Allied Publishers Pvt. Ltd.

Krishnan, M. S. (2004). *Geology of India and Burma,* CBS Publishers and distributors, New Delhi.

Krishnan, M. S. (2017). *Geology of India and Burma.* CBS Publishers and distributors.

Krishnasamy, S. (1979). *India's Mineral Resources.* Oxford & IBH Publishing Company.

Meher.,&Wadia, D. N. (1994). *Minerals of India*. New Delhi: National Book Trust.

Nathan, N.P. &Gopalakrishnan, (2022). *Geology and Mineral Resources of Tamil Nadu and Puducherry*. India: GSI.

Ramakrishnan, M., &Vaidyanadhan, R. (2010). *Geology of India*. Bangalore: GSI.

Ravindrakumar, (2015). *Fundamentals of Historical Geology and Stratigraphy of India.* New Delhi: Wiley Eastern Ltd.

Richard Dixon Oldham, (2013). *A Bibliography of Indian Geology: Being a List of Books and*

<table>
<tr><td colspan="2">Papers, relating to the Geology of British India and Adjoining Countries. Cambridge University Press.

Selvam, T.A. & Subramanian, (2002). Geology of Tamil Nadu & Pondicherry. Bangalore: Geological Society of India Publication.

Sharma, N.L., & Ram, K.S.V. (1964). Introduction to Indian Economic Mineral,Dhanbad.

Wadia, D.N. (1953). Geology of India, McMillan Publications.</td></tr>
<tr><td>Outcomes</td><td>Students would gain a holistic knowledge on various structural elements and tectonics of Tamilnadu; geology, structure, faunal content and economic importance of geological formations distributed across Tamilnadu spanning age from Archean to Quaternary</td></tr>
</table>

Semester - VI				
Course code: 22BGE6E2	**DSE-II**	**T/P**	**C**	**H/W**
	Photogeology, Remote Sensing, GIS and Mining Geology	**T**	**6**	**6**

Objectives	• To enable the learner to gain adequate knowledge on aerial and satellite remote sensing and its application in resource exploration and management. • To teach the concepts, components, software and hard ware of GIS and its application • To help learners to lean the methods of data generation, analysis and management • To know the concepts of surface and subsurface mining methods. • To learn the drilling and mining methods ensuring suitability, economic, safety for natural resources exploitation.
Unit -I	**Remote sensing - Photogeology** : definition, history of remote sensing, types of aerial photographs, scale, causes for the variation of scale, flight procedure, overlap and side lap. Factors affecting results, annotation of photographs, mosaics, types of mosaics, aerial cameras, types of films and filters. **Photogrammetry** - definition, stereoscopy and stereovision, photographic instruments- pocket stereoscope, mirror stereoscope, area measurement, relief displacement and parallax. Vertical exaggeration, factors affecting vertical exaggeration.
Unit -II	Fundamentals of aerial photo interpretation - interpretation elements – analysis based on drainage, landform and vegetation. Applications of aerial photograph in mineral and ground water exploration.
Unit -III	**Satellite Remote Sensing**-Definition, electromagnetic spectrum, EMR interaction with atmosphere and earth surface features, remote sensing platforms, sensors, multispectral scanning. Indian remote sensing satellites (IRS).
Unit -IV	**Geographic Information System:** Principles, elements, concepts and usefulness of GIS, Components of GIS, Hardware and Software. Data source, spatial data, Raster and Vector data, Topology - data analysis and application. Global Positioning System. Mapping concepts and coordinate system.
Unit -V	**Mining Geology :** Role of geology in mining industry. Definitions of mining terms: Ore, Protore, Gangue, run of mine, Shaft, Hanging wall, Adit, Roof, Drive, Cross cut, Tunnel, Raise, Winze, Stope, Assay value, Grade, Cutoff grade and Tenor. Classification of mining methods – with a brief account on open cast mining, underground mining and factors which decide the choice. An outline on problems encountered during mining operations. Mineral economics-strategic, critical and essential minerals. Conservation and substitution of minerals. National mineral policy.

Reference and Textbooks:

Agarwal, C.S. &Gang, P.K. (2000). *Text book on Remote Sensin*g, Wheel Publishing Co. Ltd.

AnjiReddy, M. (2001). *Text book of Remote Sensing and GIS*, BSP PS Publication.

Arogyasamy, R.N.P. (1986), *Courses in mining Geology*, Oxford & IBH Publishing Co.

Campbell, J.B. (2002). *Introduction to Remote Sensing*, Taylor Publications.

Drury, S.A. (1987). *Image Interpretation in Geology*, Allen and Unwin

Joseph George, (2003). *Fundamentals of Remote Sensing,* Universities Press.

Kuran, P.J. (2006). *Principle of Remote sensing*, ELBS.

Lillesand, T.M. & Kiefer, R.W. (2004). *Remote sensing and image interpretation*, John Willey sons.

Lo, C.P. and Yeung, A.K.W. (2004). *Concept and Techniques of Geographic information System*.

Manual of Remote Sensing, (1993). American Society of Photogrammetry and Remote Sensing.

Mckinstry, (1962). *Mining Geology*, Asia Publishing House.

Miller & Miller, (1961). *Photogeology*, McGraw Hill.

Moffitt, F.H. and Mikhail, E.M. (1980). *Photogrammetry*, Harper and Row.

Nag, P. and Kudrat, M. (1998). *Digital Remote Sensing*, Concept Publication.

Paine, D.P. (1981). *Aerial Photography and Image Interpretation for Resource Management*. John

Pandey, S.N. (2007). *Principle and application of Photography*, Wiley Eastern Ltd.

Paul Curran, P.J. (1983). *Principles of Remote Sensing*, Rawat Publication.

Rampal, K.K. (1999). *Hand book of Aerial Photography and Interpretation*, Concept Publication.

Sinha, K. et al., (2000). *Mineral Economics,* Oxford & IBH Publishing Co.

Verlag Jensen, J.R. (2000). *Remote Sensing of the Environment: An Earth Resource Perspective,* Prentice Hall. Wiley.

Outcomes	Learner would have known adequate information on aerial and satellite remote sensing and their application in resource exploration and management; understood the concepts, components of GIS and its application; known the data analysis and management techniques; studied surface and subsurface mining methods.

Semester - VI				
Course code: 22BGE6E3	**DSE-III**	**T/P**	**C**	**H/W**
	Hydrogeology and Engineering Geology	**T**	**6**	**6**

Objectives	• To impart knowledge on occurrence, distribution and movement of ground water • To study the geological formations as aquifer and to know the characteristics of aquifer • To know the qualities of ground water and its exploration techniques • To study various geological investigations for engineering projects
Unit -I	**Hydrogeology:** Hydrologic cycle. Definitions of meteoric water, connate water and Juvenile water. Origin of ground water, vertical distribution and occurrence of ground water. Zone of aeration, zone of saturation and water table. Springs – geological conditions favouring development of springs. Definition of aquifer, aquitard and aquiclude. Geologic formations as aquifers, types of aquifers – unconfined, confined and perched. Artesian wells, peizometric surface.
Unit -II	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.
Unit -III	Physical, chemical and biological qualities of groundwater – Water standards: BIS and WHO –Ground water recharge – natural and artificial recharge. Ground water exploration – surface methods – electrical resistivity method. An outline on status of ground water in India with special reference to Tamil Nadu.
Unit -IV	**Engineering Geology:** The role of Geology in Civil Engineering. Engineering properties of rocks – strength and elastic properties. Properties of building stones. Causes of landslides and preventive measures. Geological investigations pertaining to the foundation of bridges, buildings and highways.
Unit -V	Dam-definition and types, geological investigations for dam site and reservoir. Tunnels-definition and types. Geological investigations for tunneling. Problems related to tunneling in hard and soft grounds and remedial measures. Coastal erosion and preventive measures.

Reference and Textbooks:

Davis, S.N. and Deweist, (1966). *Hydrogeology*, John Wiley & Sons.

Karanth, K.R. (1987). *Groundwater Assessment Development and Management*, Tata McGraw Hill Publishing Company, Ltd.

Krynine, D.P. and Judd, W.R. (2005). *Principles of Engineering Geology and Geotechniques*, McGraw Hill.

Narayanaswami, B.S. (2000). *Engineering Geology*, DhanpatRai&C.Delhi.

Parbin Singh, (2003). *Engineering and general geology*, S.K.Kataria and Sons, New Delhi.

PK. Mukerjee, (2013). *A Text Book of Geology*, World Press Pvt. Ltd.

Ragunath, H.M. *Ground water*, (2007). Wiley Eastern.

Todd, D.K. (1954). (2000). *Groundwater Hydrology*, John Wiley& Sons.

Tolman, G.F. (1937). *Groundwater,* McGraw Hill. New York.

Venkat Reddy, D. *Engineering Geology for Civil Engineers*, Oxford & IBM Publishers, Delhi.

Outcomes	Students would have acquired knowledge on the occurrence, distribution and movement of ground water; understood various geological formations as aquifer; known the qualities of ground water and its exploration techniques; would be able to appreciate the role of Geologists in different engineering projects.

Semester - VI				
Course code: 22BGE6E4	**DSE-IV**	**T/P**	**C**	**H/W**
	Environmental Geology and Marine Geology	**T**	**4**	**6**

Objectives	• To know the ecosystem, natural resources, mining and associated environmental problems • To study various geological hazards • To know the origin of ocean basins and their features • To understand the concepts and theories related to plate tectonics • To study the properties and circulation of ocean water • To know the resources of the ocean and the governing laws.
Unit -I	**Environmental Geology:** Definition of ecology and environmental geology. Different ecosystems. Classification of Natural resources. A short account of renewable and nonrenewable resources. Environmental problems due to surface geological processes, causes, hazards and remedial measures relating to landslides, floods, and soil erosion, impact of wind on environment.
Unit -II	Influence of deep seated geological processes – Hazards due to earthquake and reservoir induced seismicity. Hazards of volcanism. Techniques of prediction of volcano and human adjustments to volcanic environments. Benefits of volcanism.
Unit -III	Man as an agent of environmental modification. Environmental degradation due to mining and mineral processing – effects of urbanization on surface water, causes for groundwater pollution. Degradation of coastal environment and measures for coastal protection. Population explosion and their pressure on geological environments.
Unit -IV	**Marine Geology:** Introduction and historical development. Physical features and origin of ocean basin: continental drift theory; outline of sea floor spreading. Submarine topographic forms – continental margin, ocean basin floor, mid oceanic ridge system, submarine canyons, oceanic trenches, seamounts and guyots. A brief outline of formation, development and classification of coast.
Unit -V	Physical and chemical properties of Ocean water. General oceanic circulation of water : waves and currents – Factors affecting surface flow of currents – Coriolis effect Ekman's spiral. Tides and their types. Tsunamis: origin, significance and prediction. Ocean pollution. Natural mineral resources of the ocean, law of the sea and its implications.

Reference and Textbooks:

Arthur, N. Strahler and Alan, H. Strahler, (1973). *Environmental Geosciences: Interaction between Natural System and Man*, Hamilton Publishing Co, Santa Barbara, California.

Kellar, E.A. (1979). *Environmental Geology*, Charless Merrill Publishing Co.ohio.

Kuenen, Ph.H. (1950.) *Marine Geology*, Wiley.

Lundgren, I. (1986). *Environmental Geology*, Prentice Hall.

Metaclaf, R.L.Potts, N. (Jr), *Advances in Environmental Science* (Vol.I& II), John Wiley & Sons Inc., New York.

Paul R. Pinet, (1999). *Oceanography*, West Publishing Company, USA.

Shepard, F.P. (1960). *Earth beneath the sea*, Oxford University Press.

Shepard, F.P. (1973). *Submarine Geology*, Harper and Row.

Subramanian, V. (2002). *A Text book in Environmental Science*, Narosa Publishing House, New Delhi.

Thomas, W.L. (1956). *Man's Role in Changing Face of the Earth*, University of Chicago Press.

Valdiya, K.S. (1987). *Environmental Geology – Indian Context*, Tata McGraw-Hill., New Delhi

Outcomes	Students would have known the ecosystem, natural resources, mining and associated environmental problems including geo hazards; origin of ocean basins and their features; understand the concepts and theories related to plate tectonics; studied the properties and circulation of ocean water; known the resources of the ocean and the governing laws.