TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Earth Sciences

Semester 1

Advance Mineralogy

Program:M.Sc in Applied Geology	**Year, Semester: 1st** Yr., 1st Sem.
Course Title:Advance Mineralogy	**Subject Code:**TIU-PGL-T111
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE :

Enable the student to:

1. Analyze and identify minerals using advanced techniques like XRD, SEM, and spectroscopy.
2. Understand geological processes governing mineral formation and transformations.
3. Apply mineralogical concepts in exploration, environmental studies, and industrial applications.

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO-1:	Develop crystal projections and classify minerals into crystallographic systems.	K2
CO-2:	Assess mineral formation processes in different geological settings.	K2
CO-3:	Examine relationships between crystal structures and mineral properties.	K4
CO-4:	Apply Goldschmidt's rules to predict element distribution in minerals.	K3
CO-5:	Understand crystallography, mineral classification, and mineral structures.	K3
CO-6:	Recall key physical and chemical properties of rock-forming minerals.	K3

COURSE CONTENT :

MODULE 1:	**Crystallography and Crystal projection**	**8 Hours**
Elementary ideas about crystal morphology in relation to internal structures, Crystal parameters and indices, Crystal symmetry and classification of crystals into point groups, space groups and crystal systems. Stereographic projections of symmetry elements and forms of Minerals		
MODULE 2:	**Mineral Classification**	**8 Hours**
Mineral's definition and classification;; Common physical properties of minerals (form and shape, colour, streak, luster, cleavage, fracture, hardness, tenacity, transparency, specific gravity, magnetic nature)		

MODULE 3:	**Rock forming minerals and their properties**	**8 Hours**
Minerals - definition and classification, physical and chemical properties, Substitution principles – Goldschmidt's rule of substitution of elements; partitioning of elements between coexisting phases; Processes of mineral formation (magmatic, post-magmatic, pegmatitic, weathering, sedimentary and metamorphic)		
MODULE 4:	**Special propertiesof minerals**	**8 Hours**
Brief idea about Isomorphism, Solid solution, Pseudomorphism and Polymorphism: elementary concept on principle types – common polymorphic forms of C, SiO2 and Al2SiO5 Crystal structure and its controls: bonding and coordination principles.		
MODULE 5:	**Silicate Groups**	**8 Hours**
Classification of silicate groups based on structure and derivation of structural formulae based on composition. Non-silicate structures; CCP and HCP structures		
TOTAL LECTURES		**40 Hours****

Books:

SUGGESTED READINGS:

1. Klein, C., Dutrow, B., Dwight, J., & Klein, C. (2007). The 23rd Edition of the Manual of Mineral Science (after James D. Dana). J. Wiley & Sons.
2. Kerr, P. F. (1959). Optical Mineralogy. McGraw-Hill.
3. Verma, P. K. (2010). Optical Mineralogy (Four Colour). Ane Books Pvt Ltd.
4. Deer, W. A., Howie, R. A., & Zussman, J. (1992). An introduction to the rock-forming minerals (Vol. 696). London: Longman.

Structural Geology and Tectonics of Mountain belts (TIU-PGL-T113)

Program:M.Sc in Applied Geology	**Year, Semester: 1st** Yr., 1st Sem.
Structural Geology and Tectonics of Mountain belts	**Subject Code:**TIU-PGL-T113
Contact Hours/Week: 4–0–0 (L–T–P)	**Credit:** 4

COURSE OBJECTIVE :

Enable the student to:

1. Analyze the structural features and deformation processes of mountain belts.
2. Understand the role of plate tectonics in mountain building and orogenic processes.
3. Interpret geological structures using field observations and analytical techniques.

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO-1:	Formulate models of rock behaviour under stress conditions.	K2

CO-2:	Evaluate stress and strain in geological scenarios.	K2
CO-3:	Analyze folding mechanisms, ductile structures, and shear zones.	K4
CO-4:	Apply plate tectonic principles to reconstruct past plate motions.	K3
CO-5:	Understand rheological behavior, mountain belt formation, and sedimentation.	K3
CO-6:	Recall key concepts of stress, strain, tectonics, and geomagnetism..	K3

COURSE CONTENT :

MODULE 1:	**Rheology**	**6 Hours**
Behaviors of rocks under stress; Rheological models; Flow law for steady state creep; factors influencing flow of rocks; Deformation mechanism; Estimation of paleostress.		
MODULE 2:	**Stress- Strain**	**6 Hours**
Basic concept of stress; Analysis of stress in three dimensions; stress filed description; equilibrium condition; trajectory patterns and boundary condition. Infinitesimal strain; measurement of strain; progressive deformation; Role of fluid in deformation; Rheology; Stress –Strain curves for elastic, viscous and plastic; poro-elasticity.		
MODULE 3:	**Mechanism of folding**	**6 Hours**
Mechanism of folding and superposed folding; Interpretations of ductile structures: foliation, lineation, boudinage; Structural analysis of deformed terrain, Fracture mechanics; dynamics of faulting and jointing. Shear Zones, Grain scale deformation mechanism and its manifestation in microstructure: Solid State Diffusion Creep. Granular flow and Superplasticity		
MODULE 4:	**Seismic waves**	**6 Hours**
The Interior seen by **seismic waves**, Earth's mass, shape and gravity field, Density from seismic wave velocities, Radial variations of density, pressure, temperature and composition,		
MODULE 5:	**Plate Tectonics**	**6 Hours**
Plate Tectonic theory: Plates; Boundary and margin; different types of plate boundaries and their characteristic features, earthquake focal mechanism, , reconstruction of past plate motions: finite rotations		
MODULE 6:	**Island Arc**	**6 Hours**
Its form, structure, relation to volcanic activity, sedimentation, gravity anomalies and heat flow.		
MODULE 7	**Geomagnetism**	**6 Hours**
Its concept, geomagnetic anomaly and geomagnetic reversals. Palaeomagnetism: Concept of fossil magnetism, palaeo-lattitude and plaeaomagnetic evidences in favor of continental drift theory.		
MODULE 8	**Mountain Belts**	**6 hours**
Mountain belts and its evolution		
TOTAL LECTURES		**48 Hours**

BOOKS:

1. Davis, G. R. (1984) Structural Geology of Rocks and Region. John Wiley
2. Billings, M. P. (1987) Structural Geology, 4th edition, Prentice-Hall.
3. Park, R. G. (2004) Foundations of Structural Geology.Chapman& Hall.
4. Pollard, D. D. (2005) Fundamental of Structural Geology. Cambridge University Press.
5. Ragan, D. M. (2009) Structural Geology: an introduction to geometrical techniques (4th Ed). Cambridge University Press (For Practical)
6. Lahee F. H. (1962) Field Geology. McGraw Hill

Crustal evolution and Precambrian Geology (TIU-PGL-T115)

Program:M.Sc in Applied Geology	**Year, Semester:** 1st year, 1st Sem
Course Title: Crustal evolution and Precambrian Geology	**Subject Code:**TIU-PGL-T115
Contact Hours/Week: 4–0–0 (L–T–P)	**Credit:** 4

COURSE OBJECTIVE :

Enable the student to:

1. Understand the processes of crustal formation, differentiation, and evolution through geological time.
2. Analyze the characteristics and significance of Precambrian rock assemblages and tectonic events.
3. Interpret geochemical, geochronological, and structural data to reconstruct early Earth history.

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO-1:	Develop geological models for India's crustal evolution and metallogeny.	K2
CO-2:	Evaluate spatial and temporal distribution of ore deposits.	K2
CO-3:	Analyze ore deposits, their genesis, and phase equilibria.	K4
CO-4:	Apply knowledge of Precambrian geology to assess India's cratons.	K3
CO-5:	Understand crustal evolution and Proterozoic successions.	K3
CO-6:	Recall key geological features of India's Precambrian cratons.	K3

COURSE CONTENT :

MODULE 1:	**INTRODUCTION**	**10 Hours**
Evolution of the major crustal blocks of India and metallogeny.		
MODULE 2:	**METALOGENY**	**10 Hours**
Spatial and temporal distribution of ore: Metallogenic Epoch, Metallogenic Province, Ore mineralization in relation to plate tectonics.		
MODULE 3:	**ORE GENESIS**	**8Hours**

Systematic study of ore deposits (Mode of occurrence and its importance, ore textures and their genesis, sulphide and oxide phase equilibria and its significance)		
MODULE 4:	**PRECAMBRIAN CRATON**	**10 Hours**
Brief description of distribution, stratigraphic succession, lithology, structure, metamorphism, age and mineralization of the following Precambrian to Indian Shield: Geology of the Precambrian cratons: Dharwar, Singbhum, Bastar.		
MODULE 5:	**PRECAMBRIAN STRATIGRAPHY**	**10Hours**
Brief description of Proterozoic successions of Aravalli Mountain Belt, Delhi, Vindhyan, Cuddapah, Eastern Ghats and Central India: distribution, stratigraphic succession, lithology, structure, metamorphism, age and mineralization.		
TOTAL LECTURES		**48 Hours**

Books:

1. Guilbert, J.M. and Park Jr., C.F. (1986) The Geology of Ore deposits. Freeman & Co.
2. Bateman, A.M. and Jensen, M.L. (1990) Economic Mineral Deposits. John Wiley.
3. Evans, A.M. (1993) Ore Geology and Industrial minerals. Wiley
4. Laurence Robb. (2005) Introduction to ore forming processes. Wiley.
5. Gokhale, K.V.G.K. and Rao, T.C. (1978) Ore deposits of India their distribution and processing, Tata-McGraw Hill, New Delhi.
6. Deb, S. (1980) Industrial minerals and rocks of India. Allied Publishers.
7. Sarkar, S.C. and Gupta, A. (2012) Crustal Evolution and Metallogeny in India. Cambridge Publications.

Geochemistry of Igneous, Metamorphic and Sedimentary rocks (TIU-PGL-T117)

Program:M.Sc in Applied Geology	**Year, Semester:** 1st year, 1st Sem
Course Title: Geochemistry of Igneous, Metamorphic and Sedimentary rocks	**Subject Code:**TIU-PGL-T117
Contact Hours/Week: 4–0–0 (L–T–P)	**Credit:** 4

COURSE OBJECTIVE :

Enable the student to:

1. Understand the chemical composition and processes governing the formation of igneous, metamorphic, and sedimentary rocks.
2. Analyze geochemical data to interpret rock genesis, evolution, and tectonic settings.
3. Apply geochemical principles to assess mineral resources, petrogenesis, and environmental implications.

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO-1:	Formulate geochemical models to explain element distribution and rock evolution.	K2
CO-2:	Evaluate element transport processes and isotopic fractionation.	K2
CO-3:	Analyze mineral reactions, magma variability, and trace element behavior.	K4
CO-4:	Apply aqueous geochemistry, isotope geochemistry, and thermodynamics.	K3
CO-5:	Understand element properties, redox reactions, and sedimentary geochemistry.	K3
CO-6:	Recall fundamental geochemical concepts, dating methods, and planetary evolution.	K3

COURSE CONTENT :

MODULE 1:	**ELEMENTS:**
Introductiontopropertiesofelements:Theperiodictable,chemicalbonding,statesofmatter,andatomicenvironmentsofelemer	
MODULE 2:	**ELEMENTTRANSPORT:**
Advection,diffusionChromatography.Aqueousgeochemistry:basicconcepts,speciationinsolutions,elementofmarinechem	
MODULE 3:	**MINERAL PROPERTIES**
Mineralreactions- diagenesisandhydrothermalreactions. Calculation of cation proportions; chemical formula, vacant site	
MODULE 4:	**THESOLIDEARTH**
Earth -ThesolidEarth-Geochemicalvariabilityofmagma,meltingofthemantleandgrowthofcontinentalcrust.TheEarthinthe of atmospheric composition; evidences in favour of presence of oxygen in Archean atmosphere. Formation and destruction	
MODULE 5:	**THE UNIVERSE**
Earth in relation to solar system and universe. Cosmic abundance of elements, Comparisons of planets and meteorites Structure and composition of earth and distribution of elements. Trace element geochemistry. Geochemicalbehaviourofsel	
MODULE 6:	**RADIOACTIVITY**
Different types of radioactive decay; brief outline of dating by Rb-Sr, K-Ar, Sm-Nd, U-Pb and 14C methods. I Conceptofradiogenicisotopesingeochronologyandisotopictracers:datingbyradioactivenuclides,C-14Be-10,K/Armethod,	
MODULE 7:	**GEOCHEMISTRY OF SEDIMENTARY ROCKS** **6 HOURS**
General chemical characteristics of sedimentary rocks; role of ionic potential, H-ion concentration and oxidation-reduction	
MODULE 8:	**FUNDAMENTALS OF THERMODYNAMICS**
Fundamentalsofthermodynamicsofhomogeneousandhetrogeneoussystems;intensiveandextensivevariables,nucleationan	
TOTAL LECTURES	

Books:

1. Mason,B(1986).PrinciplesofGeochemistry.3rdEdition,WileyNewYork.
2. HughRollinson(2007)Usinggeochemicaldata-evaluation.Presentationandinterpretation.2ndEdition.PublisherLongman
3. Scientific&Technical.
4. WaltherJohn,v.,2009Essentialsofgeochemistry,studentedition.JonesandBartlett Publishers
5. Deer,W.A., Howie,R.A., and Zussman, J.(1996): The rock forming minerals: Longman
6. Klein, C. and Hurlbert, C.S. (1993): Manual of mineralogy, John Willy.
7. Putnis, A. (1992): Introduction to Mineral Sciences, Cambridge University Press.
8. Spear, F.S. (1993) : Metamorphic Phase Equilibria and P-T-Time Path, Mineralogical Society of America Publication.
9. Phillips.W.R. and Grieffen, D.T.(1986): Optical Mineralogy, CBS pub.
10. Hutchinson, C.S., (1974), Laboratory Handbook of petrographic techniques: John Willey
11. Mason, B. and Moore,C.(1991)"Introduction to Geochemistry"-Willey Eastern
12. Krauskopf, K.B.(1967))"Introduction to Geochemistry"- Mcgraw-Hill.
13. Brownlow, "Geochemistry".
14. Faure, G.(1986) "Principles of Isotope geology" – John Willey.
15. Hoefs,J.(1980) "Stable Isotope Geochemistry" – Springer-Verlag.
16. Govett, G.J.S. ed. (1983) "Handbook of exploration geochemistry".Elsevier
17. Handerson,P.(1987) "Inorganic Geochemistry" – Pergamon Press.
18. Nordstron, D.K. and Munoz.J.L.(1986) "Geochemistry Thermodynamics – Blackwell.
19. Albarede. F. (2003), "Geochemistry-an Introduction"- Cambridge University Press. U.K.

Sedimentology and basin analysis (TIU-PGL-T119)

Program:M.Sc in Applied Geology	**Year, Semester:** 1st year, 1st Sem
Course Title: Sedimentology and basin analysis	**Subject Code:**TIU-PGL-T119
Contact Hours/Week: 4–0–0 (L–T–P)	**Credit:** 4

COURSE OBJECTIVE :

Enable the student to:

1. Understand sedimentary processes, depositional environments, and stratigraphic principles.
2. Analyze sedimentary facies, diagenesis, and basin evolution using field and laboratory techniques.
3. Interpret basin dynamics, tectonic influences, and resource potential through sedimentological data.

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO-1:	Develop sedimentary facies models for depositional environments.	K2
CO-2:	Evaluate environmental parameters controlling sedimentation.	K2

CO-3:	Analyze sedimentary environments using facies models.	K4
CO-4:	Apply principles of basin analysis to various tectonic settings.	K3
CO-5:	Understand sedimentary processes, basin development, and stratigraphic cycles.	K3
CO-6:	Recall key concepts of sedimentary environments, facies models, and basin analysis techniques.	K3

COURSE CONTENT :

MODULE 1:	**INTRODUCTION**
Conceptsofsedimentaryenvironment.Environmentalparametersandcontrols.Classificationofenvironments:ClasticandCh	
MODULE 2:	**SEDIMENTARYENVIRONMENT**
Faciesmodelandenvironmentalreconstruction:GlacialEnvironment,Alluvialenvironment(Braided,Meandering),Margina deltaic)model-barrierislandsandlagoons,tidalchannels,tidaldeltasandEstuaries. Deepmarinesedimentation:SlopeandBasin-floorfans(PointandLinesource)	
MODULE 3:	**CARBONATESEDIMENTATIONMODEL**
Geometryofcarbonateplatforms;Ramp,Rimmedshelves,Isolatedplatform,Reefs: Cyclicsediments:AllokineticandAutoki	
MODULE 4:	**BASINANALYSIS**
Definitionandscopeofbasinanalysis.Basinmappingmethods:structureandisopachcontouring,lithofaciesmaps,palaeo-curr Regionalandglobalstratigraphiccycles.	
TOTAL LECTURES	

Books:

1.PrinciplesofSedimentologyandStratigraphy,2006.SamBoggs(Jr.),PrenticeHall
2.SedimentaryEnvironments:processes,FaciesandStratigraphy:(1996)H.G.Reading.Blackwellpublisher
s
3.CarbonateSedimentology:M.E.TuckerandV.PWright(1990),Blackwell
4.SedimentaryBasins:GeraldEinsele(2000)Springer
5.FaciesModelsrevisited:H.W.PosamentierandRG.walker(2006),SEPM
6.Principlesofsedimentarybasinanalysis:A.D.Miall(1999),Springer.
7. SedimentologyandStratigraphy.GaryyNichols(2009),Wiley-Blackwell

Mineralogy Practical (TIU-PGL-L111)

Program:M.Sc in Applied Geology	**Year, Semester:** 1st year, 1st Sem
Course Title: Mineralogy Practical	**Subject Code:**TIU-PGL-L111
Contact Hours/Week: 0–0–2 (L–T–P)	**Credit: 2**

COURSE OBJECTIVE :

Enable the student to:

1. Identify and classify minerals using physical, optical, and crystallographic properties.
2. Analyze mineral compositions using microscopic, XRD, and spectroscopic techniques.
3. Interpret mineralogical data for geological and industrial applications.

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO-1:	Develop practical skills in identifying and classifying minerals.	K2
CO-2:	Evaluate physical and optical properties of minerals.	K2
CO-3:	Analyze crystal symmetry and optical characteristics of minerals.	K4
CO-4:	Apply mineralogical techniques to identify minerals in hand specimens and thin sections.	K3
CO-5:	Understand physical and optical properties of major minerals.	K3
CO-6:	Recall key physical and optical characteristics of common minerals.	K3

COURSE CONTENT :

MODULE 1:	**CRYSTAL IDENTIFICATION**	**8 Hours**
Study of the symmetry of crystals		
MODULE 2:	**HAND SPECIMEN IDENTIFICATION**	**8 Hours**
Study of physical properties of minerals in hand specimen: Olivine, Garnet, SilIimanite, Kyanite, Staurolite, Beryl, Tourmaline, Pyroxene, Actinolite, Tremolite, Hornblende, Serpentine, Talc, Muscovite, Biotite, Quartz, Alkali feldspar, Plagioclase, Nepheline, Sodalite, Zeolite,Pyrite, Chalcopyrite, Galena, Sphalerite, Graphite, Magnetite, Haematite, Fluorite, Calcite, Dolomite, Gypsum, Asbestos, Ilmenite, Chromite, Pyrolusite, Psilomelane, Bauxite		
MODULE 3:	**OPTICAL PROPERTIES OF MINERALS**	**8 Hours**
Study of optical properties of common rock-forming minerals: quartz, orthoclase, microcline, plagioclase, perthite, nepheline, olivine, orthopyroxene, clinopyroxene, hornblende, staurolite, garnet, muscovite, biotite, calcite		
TOTAL LECTURES		**24 Hours****

STRUCTURAL GEOLOGY PRACTICAL (TIU-PGL-L113)

Program:M.Sc in Applied Geology	**Year, Semester:** 1st year, 1st Sem
Course Title: Structural geology Practical	**Subject Code:**TIU-PGL-L113
Contact Hours/Week: 0–0–2 (L–T–P)	**Credit: 2**

COURSE OBJECTIVE :

Enable the student to:

1. Interpret geological structures through field observations, maps, and cross-sections.
2. Analyze deformation patterns using stereographic projections and structural contouring techniques.

3. Apply kinematic and dynamic principles to understand stress, strain, and tectonic movements.

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO-1:	Develop proficiency in constructing geological cross-sections and interpreting outcrop patterns.	K2
CO-2:	Evaluate structural data and apply stereographic projection techniques.	K2
CO-3:	Analyze geological maps and structural data to understand deformation patterns.	K4
CO-4:	Apply stress and strain measurement techniques to solve structural geology problems.	K3
CO-5:	Understand principles of structural geology, including stereographic projection and stress-strain relationships.	K3
CO-6:	Recall key concepts related to outcrop patterns, stereographic projections, and stress-strain measurements.	K3

COURSE CONTENT :

MODULE 1	**GEOLOGICAL MAP- INTRODUCTION**	8 HOURS
Introduction to Geological maps: Lithological and Structural maps		
MODULE 2:	**STRUCTURAL CONTOURING**	8 HOURS
Structural contouring and 3-point problems of dip and strike : stereographic projections of mesoscopic structural data (planar, linear, folded etc.)		
MODULE 3:	**DRAWING PROFILE SECTIONS**	8 HOURS
Drawing profile sections and interpretation of geological maps of different complexities		
TOTAL LECTURES		**24 Hours**

Sedimentology Practical (TIU-PGL-L119)

Program:M.Sc in Applied Geology	**Year, Semester:** 1st year, 1st Sem
Course Title: Sedimentology Practical	**Subject Code:**TIU-PGL-L119
Contact Hours/Week: 0–0–2 (L–T–P)	**Credit: 2**

COURSE OBJECTIVE :

Enable the student to:

1. Identify and classify sediments and sedimentary rocks based on texture, composition, and structures.

2. Analyze grain size, roundness, sorting, and mineralogical characteristics using laboratory techniques.
3. Interpret depositional environments and basin evolution through sedimentary facies analysis.

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO-1:	Develop skills in analysing sedimentary structures and petrographic studies.	K2
CO-2:	Evaluate particle size distribution and interpret paleocurrent data.	K2
CO-3:	Analyse sedimentary structures and paleocurrent directions.	K4
CO-4:	Apply techniques for sedimentary analysis and petrographic studies.	K3
CO-5:	Understand sedimentary processes and statistical analysis in sedimentology.	K3
CO-6:	Recall sedimentary structures, particle size distribution, and paleocurrent analysis techniques.	K3

COURSE CONTENT :

MODULE 1:	**PRIMARY SEDIMENTARY STRUCTURE**	**4 Hours**
Identification of primary sedimentary structure from hand specimen		
MODULE 2:	**GRAIN SIZE DISTRIBUTION**	**4 Hours**
Grain size distribution and statistical analysis		
MODULE 3:	**PALEOCURRENT ANALYSIS**	**2 Hours**
Palaleo current analysis from hand specimen		
MODULE 4:	**HAND SPECIMEN IDENTIFICATION**	**7 Hours**
Hand specimen study of clastic and non-clastic rocks in hand specimens		
MODULE 5:	**PETROGRAPHIC STUDY UNDER MICROSCOPE**	**7 Hours**
Thin section study		
TOTAL LECTURES		**24 Hours**

Semester 2

Petrogenesis and Tectonics (TIU-PGL-T110)

Program:M.Sc in Applied Geology	**Year, Semester: 1st** Yr., 2nd Sem.
Course Title: Petrogenesis and Tectonics	**Subject Code:**TIU-PGL-T110
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE :

Enable the student to:

1. Understand the processes governing the formation and evolution of igneous and metamorphic rocks.
2. Analyze the relationship between petrogenesis and global tectonic settings.
3. Interpret geochemical and petrological data to reconstruct tectonic histories.

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO-1:	Formulate models of magmatic evolution using variation diagrams.	K2
CO-2:	Evaluate oxygen fugacity and geochemical criteria for paleo-tectonic settings.	K2
CO-3:	Analyze mantle composition, magma ascent, and classification of igneous rocks.	K4
CO-4:	Apply petrogenesis and tectonic principles to igneous rock distribution.	K3
CO-5:	Understand classification, occurrence, and significance of igneous rocks.	K3
CO-6:	Recall key concepts related to phase equilibria and igneous provinces.	K3

COURSE CONTENT :

MODULE 1:	**PHASE EQUILIBRIA**	**8 Hours**
Phase equilibria studies in binary, ternary and quaternary silicate system with reference to petrogenesis; Cryoscopic equation; Solubility of H_2O, CO_2 , S etc. in silicate melts; Role of oxygen fugacity in phase equlibria.		
MODULE 2:	**PARTIAL MELTING**	**8 Hours**
Physical state, chemical and mineralogical composition of upper mantle; Partial melting processes in the upper mantle; Segregation and ascent of magma.		
MODULE 3:	**PHASE DIAGRAM**	**8 Hours**
Variation diagrams and their uses to model magmatic evolution; Stable and radiogenic isotopic composition and their role in igneous petrognenesis; Geochemical criteria to identify palaeo-tectonic settings; Distribution of igneous rocks in space and time.		
MODULE 4:	**IGNEOUS PROVINCES**	**8 Hours**
Major igneous provinces and their tectonic interpretation.		
MODULE 5:	**MAJOR ELEMENTS ,TRACE ELEMENTS AND IGNEOUS ROCKS**	**8 Hours**
Applicationofmajorandtraceelementsinpetrogenesis.Constructionofvariationdiagrams Classificationof Traceelement.Geologicalcontrolsoftraceelementsdistributions,Rareearthelementsandtheirapplicationt opetrogenesis.		
TOTAL LECTURES		**40 Hours****

BOOKS:

1 Bose;M.K. (1997) Igneous petrology, The World Press Pvt. Ltd.
2 Hall, A.,(1996) Igneous petrology, Longman Group Ltd. England.

3 McBirney.A.R.(1994), Igneous petrology, CBS Pub.& Distributors.
4 Philpotts.A.R.(1994) Principles of igneous and metamorphic petrology, Prentice Hall
5 Wilson.M. (1989) Igneous petrogenesis, Unwin-Hyman.
6. Winter.J.D.(2001) An introduction to igneous and metamorphic petrology,Prentice Hall.

Ore geology and deposit modelling (TIU-PGL-T112)

Program:M.Sc in Applied Geology	**Year, Semester: 1st** Yr., 2nd Sem.
Course Title:Ore geology and deposit modelling	**Subject Code:**TIU-PGL-T112
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE :

Enable the student to:

1. Understand the formation processes, classification, and distribution of ore deposits.
2. Analyze the geological, geochemical, and structural controls on mineralization.
3. Apply deposit modeling techniques for mineral exploration and resource assessment.

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO-1:	Understand ores, gangue minerals, tenor, grade, and ore formation processes.	K2
CO-2:	Evaluate historical concepts of ore genesis and mineral deposits.	K2
CO-3:	Analyze mineral exploration techniques, including remote sensing and geophysical methods.	K4
CO-4:	Apply knowledge of ore body structures, endogenous and exogenous processes in ore formation.	K3
CO-5:	Assess ore grades, reserve estimation, and classification of metallic and non-metallic ores.	K3
CO-6:	Recall key concepts of metallogenic provinces, industrial minerals, and gemstone deposits in India.	K3

COURSE CONTENT :

MODULE 1:	**ORES AND GANGUES**	**4 Hours**
Ores, gangue minerals, tenor, grade and lodes, Resources and reserves- Economic and Academic definitions , Processesofformationofores		
MODULE 2:	C**LASSICAL CONCEPTS OF ORE FORMATION**	**8 Hours**
Mineral occurrence, Mineral deposit and Ore deposit ,Historical concepts of ore genesis: Man's earliest vocation- Mining ,Plutonist and Neptunist concepts of ore genesis		
MODULE 3:	**MINERAL EXPLORATION:**	**6 Hours**
Exploration and exploitation techniques, Brief outline of Remote Sensing, Geophysical and Geochemical		

Explorations ,Geological mapping at different scales, drilling, borehole logs and transverse sections		
MODULE 4:	**STRUCTURE AND TEXTURE OF ORE DEPOSITS**	**7 Hours**
Concordant and discordant ore bodies Endogenous processes: Magmatic concentration, skarns, greisens, and hydrothermal deposits Exogenous processes: weathering products and residual deposits, oxidation and supergene enrichment, placer deposits.		
MODULE 5:	**GRADE AND RESERVE**	**7 Hours**
Assessment of grade of ore; reserve estimation		
MODULE 6:	**METALLIC AND NONMETALLIC ORES**	**7 Hours**
Metallogenic provinces and epochs, Important deposits of India including atomic minerals Non-metallic and industrial rocks and minerals, in India;Introduction to gemstones.		
TOTAL LECTURES		**39 Hours**

BOOKS:

Guilbert, J.M. and Park Jr., C.F. (1986) The Geology of Ore deposits. Freeman & Co.
2. Bateman, A.M. and Jensen, M.L. (1990) Economic Mineral Deposits. John Wiley.
3. Evans, A.M. (1993) Ore Geology and Industrial minerals. Wiley
4. Laurence Robb. (2005) Introduction to ore forming processes. Wiley.
5. Gokhale, K.V.G.K. and Rao, T.C. (1978) Ore deposits of India their distribution and processing, Tata-McGraw Hill, New Delhi.
6. Deb, S. (1980) Industrial minerals and rocks of India. Allied Publishers.
7. Sarkar, S.C. and Gupta, A. (2012) Crustal Evolution and Metallogeny in India. Cambridge Publications.

Stratigraphic Principles and Phanerozoic Stratigraphy (TIU-PGL-T114)

Program:M.Sc. in Applied Geology	**Year, Semester:** 1st year, 2nd Sem
Course Title: Stratigraphic Principles and Phanerozoic Stratigraphy	**Subject Code:**TIU-PGL-T114
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE :

Enable the student to:

1. Understand fundamental stratigraphic principles, including lithostratigraphy, biostratigraphy, and sequence stratigraphy.

2. Analyze the stratigraphic record to interpret Earth's geological history and major Phanerozoic events.
3. Correlate rock sequences globally using fossils, isotopic dating, and sedimentological data.

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO-1:	Develop stratigraphic maps and cross-sections across geological time.	K2
CO-2:	Evaluate stratigraphic units and their role in geological history.	K2
CO-3:	Analyze dynamic stratigraphy concepts like chemo-stratigraphy and sequence stratigraphy.	K4
CO-4:	Apply knowledge of GSSPs to age dating and geological correlation.	K3
CO-5:	Understand Phanerozoic stratigraphic architecture and its tectonic influences.	K3
CO-6:	Recall key stratigraphic successions and boundary problems in Indian geology.	K3

COURSE CONTENT :

MODULE 1:	**INTRODUCTION**	**8 Hours**
Stratigraphic classification; Stratigraphic subdivisions – Archean to recent – their characteristics		
MODULE 2:	**STRATIGRAPHIC UNITS**	**8 Hours**
Definition of litho-stratigraphic, biostratigraphic and chrono-stratigraphic units, Introduction to concepts of dynamic stratigraphy: chemostratigraphy, seismic stratigraphy, sequence stratigraphy, Magneto-stratigraphy ;International Stratigraphic Code – development of a standardized stratigraphic nomenclature.		
MODULE 3:	**PHANEROZOIC STRATIGRAPHY OF INDIA**	**12 Hours**
Paleozoic Succession of Kashmir and its correlatives from Spiti and Zanskar Stratigraphy Stratigraphy of Gondwana basins; **Mesozoic** stratigraphy of India: a. Triassic successions of Spiti, b. Jurassic of Kutch, c. Cretaceous successions of Cauvery basins; **Cenozoic** stratigraphy of India: a. Kutch basin, b. Siwalik successions, c. Assam d. Bengal basins. Volcanic provinces of India: a. Deccan, b. Rajmahal, c. Sylhet Trap		
MODULE 4:	**PHANEROZOIC STRATIGRAPHY**	**4 Hours**
Overview of Indian Phanerozoic stratigraphic architecture in the light of modern concepts of eustasy and global tectonics		
MODULE 5:	**BOUNDARY PROBLEMS**	**8 Hours**
Boundary problems and their critical evaluation in the context of Indian stratigraphy of the A-P, Precambrian-Cambrian, P-T, K-T boundaries		
TOTAL LECTURES		**40 Hours****

Books:

SUGGESTED READINGS:

1. Krishnan, M. S. (1982) Geology of India and Burma, CBS Publishers, Delhi
2. Doyle, P. & Bennett, M. R. (1996) Unlocking the Stratigraphic Record. John Wiley
3. Ramakrishnan, M. &Vaidyanadhan, R. (2008) Geology of India Volumes 1 & 2, Geological society of India, Bangalore.
4. Valdiya, K. S. (2010) The making of India, Macmillan India Pvt. Ltd.

Advance Paleontology (TIU-PGL-T116)

Program:M.Sc in Applied Geology	**Year, Semester:** 1st year, 2nd Sem
Course Title:Advance Paleontology	**Subject Code:TIU-PGL-T116**
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE :

Enable the student to:

1. Understand the evolutionary history, classification, and functional morphology of fossil organisms.
2. Analyze fossil records to interpret paleoecology, paleoclimate, and biogeographic patterns.
3. Apply advanced paleontological techniques for biostratigraphy, paleoenvironmental reconstruction, and evolutionary studies.

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO-1:	Formulate a framework for paleontological concepts and taxonomy.	K2
CO-2:	Evaluate theories on the emergence of life and evolutionary significance of key groups.	K2
CO-3:	Analyze biostratigraphic techniques and fossil applications in Indian stratigraphy.	K4
CO-4:	Apply micropaleontological methods to environmental and tectonic interpretations.	K3
CO-5:	Understand mass extinctions, their causes, and vertebrate evolution.	K3
CO-6:	Recall detailed knowledge of palynology and its role in paleontological studies.	K3

COURSE CONTENT :

MODULE 1:	**BASIC PALAENTOLOGY**	**8 Hours**
Species concept,Growth and allometry,Evolutionary Systematics- – Numerical Taxonomy, Cladistic Taxonomy,Evolution theories, modes, patterns, processes and trends, Functional morphology, Palaeoecology and Palaeobiogeography		
MODULE 2:	**EMARGENCE OF LIFE**	**8 Hours**
Theories, present status, evidence of life in Tethyan Basin; Evolution of Ammonoidea and Equidae as examples of studying evolution		
MODULE 3:	**BIOSTRAIGRAPHY**	**8 Hours**
Application of fossils in age determination and correlation. Important invertebrate fossils, vertebrate, fossils, plant fossils and microfossils in Indian stratigraphy. Conodonts and their role in biostratigraphy.		
MODULE 4:	**MICROPALAEONTOLOGY**	**8 Hours**
Introduction, micro vs. mega palaeontology, importance. Microfossils: types, environmental significance of microfossils. Use of microfossils in interpretation of sea floor tectonism. Application of micropaleontology in hydrocarbon exploration. Oxygen and Carbon isotope studies of microfossils and their use in paleoceanographic and paleoclimatic interpretation; Foraminifera: morphology, palaeocology, evolution		
MODULE 5:	**MASS EXTINCTIONS**	**2 Hours**
Mass extinction and their causes; rate of extinction and evolution.		
MODULE6:	**PALYNOLOGY**	**4 Hours**
Introduction, palynomorphs, morphology of spores and pollens, Wall Stratification of Spore and Pollen.		
MODULE7:	**VERTEBRATE PALEANTOLOGY**	**4 HOURS**
Major trends in **vertebrate evolution**, Dinosaur: major subdivision, a broad account through ages, Indian occurrences, causes of extinction		
TOTAL LECTURES		**42 Hours**

Suggested Readings:

1 Raup, D.M. and Stanley, S.M.(1985):Principles of Palaeontology CBS Publishers & Dist.
2 Stern,C.W. and Carroll,R.L. (1989):Palaeontology- the record of life. John Wiley.
3 Prothero,D.R.(1998) : Bringing fossils to life- an introduction to palaeobiology McGrow Hill
4 Brasier, M.D.(1980): Microfossils, George Allen & Unwin, London
5 Bignot,G.(1985): Elements of Micropalaeontology Graham & Trotman Ltd. London
6 Haq. B.U. and Boersma. A.(Eds).(1978): Introduction to Marine Micropalaeontology, Elsevier, New York.

Metamorphism and Metamorphic belts,TIU-PGL-T118

Program:M.Sc in Applied Geology	**Year, Semester:** 1st Yr., 2nd Sem
Course Title: Machine Learning	**Subject Code:TIU-PGL-T118**
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE :

Enable the student to:

1. Understand the principles of metamorphism, metamorphic reactions, and facies classification.
2. Analyze the pressure-temperature conditions and tectonic settings of metamorphic belts.
3. Interpret metamorphic textures, mineral assemblages, and their implications for crustal evolution.

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO-1:	Develop a comprehensive understanding of metamorphic processes.	K2
CO-2:	Evaluate factors controlling metamorphism and their geological impact.	K2
CO-3:	Analyze equilibrium conditions and apply geothermobarometry.	K4
CO-4:	Apply concepts of metamorphic facies and mineral stability.	K3
CO-5:	Understand relationships between metamorphism and tectonism.	K3
CO-6:	Recall knowledge of metamorphic rock associations and their significance.	K3

COURSE CONTENT :

MODULE 1:	**INTRODUCTION**	**3Hours**
Definition of metamorphism; factors controlling metamorphism; types of metamorphism - contact, regional, fault zone metamorphism, impact metamorphism.		
MODULE 2:	**QUANTIFICATION OF EQUILIBRIUM IN METAMORPHISM**	**5 Hours**
Metamorphic rocks as geochemical systems; Application of chemical thermodynamics in homogeneous phase equilibria; Geothermobarometry		
MODULE 3:	**METAMORPHIC FACIES AND GRADES**	**8 Hours**
Concept of equilibrium; Index minerals; composition paragenesis diagram (ACF, AKF, AFM projection); metamorphic zones and isograds. Concept of metamorphic facies and grade; mineralogical phase rule of closed and open system		
MODULE 4:	**METAMORPHISM AND TECTONISM**	**8 Hours**
Relationship between metamorphism and deformation; structure and textures of metamorphic rocks; metamorphic mineral reactions (prograde and retrograde); Metamorphic Facies Series; Paired Metamorphic Belt.		
MODULE 5:	**TYPES OF METAMORPHISM**	**8 Hours**
Progressive metamorphism of pelitic and basic rocks; Contact metamorphism of impure limestone; Crustal anatexis, Partial melting in metamorhic rocks; Migmatites and their origin; Metasomatism and		

role of fluids in metamorphism.		
MODULE 6:	**METAMORPHIC ROCK ASSOCIATIONS**	**8 Hours**
Schists, gneisses, khondalites, charnockites, blue schists and eclogites.		
TOTAL LECTURES		**40 Hours**

Books:

1. Philpotts, A- Principles of Igneous and Metamorphic Petrology
2. Miyashhiro, A – Metamorphism and metamorphic belts
3. Ashworth, (ed)-Migmatites.
4.. Bucher, K and Frey, M – Petrogenesis of metamorphic rocks
5. Yardley, B.W.D.: - An introduction to metamorphic petrology.
6. Winter, J.D – An introduction to Igneous and Metamorphic Petrology

Ore Geology Practical (TIU-PGL-L112)

Program:M.Sc in Applied Geology	**Year, Semester: 1st year, 2nd Sem**
Course Title: Ore Geology Practical	**Subject Code:**TIU-PGL-L112
Contact Hours/Week: 0–0–2 (L–T–P)	**Credit: 2**

COURSE OBJECTIVE :

Enable the student to:

1. Identify and classify ore minerals using physical, optical, and geochemical properties.
2. Analyze ore textures, mineral associations, and paragenetic sequences under a microscope.
3. Interpret ore deposit characteristics for exploration and economic assessment.

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO-1:	Create a detailed megascopic identification guide for ore-forming minerals.	K2
CO-2:	Evaluate microscopic properties of ore-forming minerals (oxides &sulfides).	K2
CO-3:	Analyze distribution patterns of ores and economic minerals in India.	K4
CO-4:	Apply mineral identification techniques and mapping skills in practical scenarios.	K3
CO-5:	Understand geological processes leading to ore formation.	K3
CO-6:	Recall fundamental knowledge of key ore-forming minerals.	K3

COURSE CONTENT :

MODULE 1:	**HAND SPECIMEN IDENTIFICATION**	**8 Hours**
Megascopic identification		

MODULE 2:	**STUDY UNDER MICROSCOPE**	**8 Hours**
Study of microscopic properties of ore forming minerals (Oxides and sulphides).		
MODULE 3:	**MAP**	**8 Hours**
Preparation of maps showing distribution of important ores and other economic minerals in India		
TOTAL LECTURES		**24Hours****

Books:

Books:

1. Philpotts, A- Principles of Igneous and Metamorphic Petrology
2. Miyashhiro, A – Metamorphism and metamorphic belts
3. Ashworth, (ed)-Migmatites.
4.. Bucher, K and Frey, M – Petrogenesis of metamorphic rocks
5. Yardley, B.W.D.: - An introduction to metamorphic petrology.
6. Winter, J.D – An introduction to Igneous and Metamorphic Petrology

Paleontology Practical (TIU-PGL-L116)

Program:M.Sc in Applied Geology	**Year, Semester: 1ST** Yr., 2nd Sem.
Course Title:Paleontology Practical	**Subject Code:TIU-PGL-L116**
Contact Hours/Week: 0–0–2 (L–T–P)	**Credit: 2**

COURSE OBJECTIVE :

Enable the student to:

1. Identify and classify fossils based on morphology, taxonomy, and preservation.
2. Analyze fossil assemblages to interpret paleoecology, paleoenvironments, and evolutionary trends.
3. Apply biostratigraphic principles for age dating and correlation of rock sequences.

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO-1:	Create detailed morphological profiles of fossil groups from Indian stratigraphy.	K2
CO-2:	Evaluate microfossils and plant fossils for paleoecological analysis.	K2
CO-3:	Analyze biostratigraphic data for fossil assemblages and chronology.	K4
CO-4:	Apply techniques for biostratigraphic zonation and correlation.	K3
CO-5:	Understand morphological significance in paleoenvironments and climate reconstruction.	K3
CO-6:	Recall key fossil groups and their stratigraphic importance.	K3

COURSE CONTENT :

MODULE 1:	**SPECIES IDENTIFICATION**	**8 Hours**
Morphological studies on the following mainly from different levels of Indian stratigraphy as mentioned in bivalves: Gastropods (Cenozoic), Cephalopods – mainly ammonites (Mesozoic), Brachiopods (Paleozoic), Echinoids (Cenozoic).		
MODULE 2:	**MICRO FOSSILS**	**8 Hours**
Study of microfossils, Morphologic studies on plants with special reference to Indian Gondwana. Studies on features of palaeoclimatic importance.		
MODULE 3:	**TRACE FOSSILS**	**8 Hours**
Trce fossils identification		
TOTAL LECTURES		**24 Hours****

Metamorphic and Igneous Petrology Practical (TIU-PGL-L118)

Program:M.Sc in Applied Geology	**Year, Semester:** 1st Yr., 2nd Sem
Course Title: Metamorphic and Igneous Petrology Practical	**Subject Code:**TIU-PGL-L118
Contact Hours/Week: 0–0–2 (L–T–P)	**Credit: 2**

COURSE OBJECTIVE :

Enable the student to:

1. Identify and classify metamorphic and igneous rocks using hand specimens and thin sections.
2. Analyze mineral assemblages, textures, and microstructures under a petrographic microscope.
3. Interpret petrogenetic processes and tectonic settings based on mineralogical and textural observations.

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO-1:	Create comprehensive hand specimens and thin sections for rock analysis.	K2
CO-2:	Evaluate igneous rock samples using variation diagrams for petrogenetic interpretation.	K2
CO-3:	Analyze textural and mineralogical characteristics of metamorphic rocks.	K4
CO-4:	Apply petrological knowledge to interpret thin sections of various rock types.	K3
CO-5:	Understand mineral composition, texture, and metamorphic grade relationships.	K3
CO-6:	Recall foundational knowledge of igneous and metamorphic rock types.	K3

COURSE CONTENT :

MODULE 1:	**HAND SPECIMEN IDENTIFICATION-IGNEOUS ROCK**	**6 Hours**
Study of important igneous rocks in hand specimens and thin sections- granite, granodiorite, diorite, syenite, nepheline syenite, gabbro, anorthosites, ultramafic rocks, basalts, andesites.		
MODULE 2:	**HANDS ON PROBLEMS**	**6 Hours**
Hands on problems related to following variation diagrams: Total alkali-silica diagram, Harker variation diagram, FeOT – MgO – (Na2O + K2O) diagram; their implications to draw petrogenetic conclusions, thin sections- granite, granodiorite, diorite, gabbro, anorthosites, ultramafic rocks, basalts, andesites, trachyte, rhyolite, dacite.		
MODULE 3:	**MEGASCOPIC AND MICROSCOPIC STUDY OF TEXTURE**	**6 Hours**
Megascopic and microscopic study (textural and mineralogical) of the following metamorphic rocks: Low grade metamorphic rocks: serpentinites, albite-epidote-chloritequartz schist, slate, talc-tremolite-calcite-quartz schist.		
MODULE 4:	**HAND SPECIMEN IDENTIFICATION OF METAMORPHIC ROCK**	**6 Hours**
Medium to high grade metamorphic rocks: Gneisses, amphibolite, hornfels, garnetiferous schists, sillimanite-kyanite-bearing rocks, Granulites, eclogite, diopside-forsterite marble.		
TOTAL LECTURES		**32 Hours****

Field Training (Compulsory) (TIU-PGL-P112)

Program:M.Sc in Applied Geology	**Year, Semester:** 1st Yr., 2nd Sem
Course Title: Field Training (Compulsory)	**Subject Code:**TIU-PGL-P112
Contact Hours/Week: 0–0–2 (L–T–P)	**Credit: 4**

Course Objective: To provide students with practical field training experience in real-world settings related to their academic discipline.

Course Outcome: Students will be demonstrated competence in applying theoretical knowledge to practical scenarios, enhancing their professional skills and readiness for future career opportunities.

Semester 3

Hydrogeology and Ground water exploration (TIU-PGL-T211)

Program:M.Sc in Applied Geology	**Year, Semester:** 2nd Yr., 1st Sem.
Course Title: **Hydrogeology and Ground water exploration**	**Subject Code:**TIU-PGL-T211

Contact Hours/Week: 4–0–0 (L–T–P)	**Credit: 4**

COURSE OBJECTIVE :

Enable the student to:

1. Understand the occurrence, movement, and distribution of groundwater in various geological settings.
2. Analyze aquifer properties, groundwater flow, and hydrogeochemical characteristics.
3. Apply geophysical and remote sensing techniques for groundwater exploration and management.

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO-1:	Understand the hydrologic cycle and origin of water types.	K2
CO-2:	Analyze rainfall-runoff data and surface-groundwater interactions.	K2
CO-3:	Evaluate subsurface groundwater movement and aquifer properties.	K4
CO-4:	Design and develop effective well systems using hydrogeological principles.	K3
CO-5:	Assess groundwater quality and contamination issues.	K3
CO-6:	Utilize advanced groundwater exploration techniques.	K3

COURSE CONTENT :

MODULE 1:	**ORIGINOFWATER**	**6 Hours**
Meteoric,juvenile,magmaticandseawaters.Hydrologiccycle.Rain fall-run-offanalysis,streamdischargeparametersanditsmeasurement,infiltrationandevapotranspiration.Hydrographs;Stage-dischargerelationshipandratingcurves;Surfacewaterandgroundwaterinteraction.		
MODULE 2:	**GROUND WATER MOVEMENT**	**6 Hours**
Springs.Classificationofaquifers.Flownets.Conceptsofdrainagebasinandgroundwaterbasin.Hydrological propertiesofrocks-specificyield,specificretention,porosity,hydraulicconductivity,transmissivity,storagecoefficient.Watertablefluctuations-causativefactors,conceptofbarometricandtidalefficiencies.Watertablecontourmaps.Classificationofrockswithrespecttotheirwaterbearingcharacteristics.Hydrostratigraphicunits.GroundwaterprovincesofIndia.HydrogeologyofaridzonesofIndia.		
MODULE 3:	**WELLHYDRAULICSANDWELLDESIGN**	**7 Hours**
Theoryofgroundwaterflow,Darcy'sLawanditsapplications,Typesofwells,drillingmethods,construction,design,developmentandmaintenanceofwells,-specificcapacityanditsdetermination.Unconfined,confined,steady,unsteadyandradialflowconditions.Pumpingtests-methods,dataanalysisandinterpretations;WellPerformanceTests,EvaluationofaquiferparametersusingThiem,Theis,JacobandWaltonmethods. Different method of groundwatermodelling–numericalandelectricalmodels		
MODULE 4:	**GROUNDWATERCHEMISTRY**	**7 Hours**
Groundwaterquality-		

physicalandchemicalpropertiesofwater,qualitycriteriafordifferentuses,graphicalpresentationofwaterquality data,groundwaterqualityindifferentprovincesofIndia-problemsofarsenicandfluoride.Salinewaterintrusionincoastalandotheraquifersanditsprevention.Radioisotopesinhydrogeologicalstudies.Groundwatercontamination.Applicationofisotopesastracerandbudgetingtool.		
MODULE 5:	**GROUNDWATEREXPLORATION**	**7 Hours**
Geological-lithologicalandstructuralmapping,fracturetraceanalysis.Hydrogeological-lithologicalclassificationwithrespecttohydrologicproperties.Hydraulliccontinuityinrelationtogeologicstructures.Locationofsprings.Remotesensing-hydrogeomorphicmappingoftheterrainusingdifferentimagesofdifferentsatellitemissions.Lineamentmapping.Shallow groundwaterpotentialzonemappingusingsatelliteImages.electricalresistivity,seismic,gravityetc.Subsurfacegeophysicalmethods–wellloggingfordelineationofaquifersandestimationofwaterquality.		
MODULE 6:	**GROUNDWATERPROBLEMSANDMANAGEMENT**	**7 Hours**
Groundwaterproblemsrelatedtofoundationwork,mining,canals,damsreservoirsandtunnelsProblemsof over exploitationandgroundwatermining.Groundwaterdevelopmentinurbanareasandrainwaterharvesting.Artificialrechargemethods.Groundwaterproblemsandremediation.Groundwaterbalanceandmethodsofestimation.Groundwaterlegislation.Sustainabilitycriteriaandmanagingrenewalnonrenewalgroundwaterresources.		
MODULE 7:	**WATER FLOW**	**6 Hours**
HydraulicHead,jumpingTests,Reynold'snumber,ForcePotentialandHydraulicHead,Equationsofgroundwaterflowforconfinedandunconfinedaquifers,FlowNets,SteadyRadialFlowinconfinedandunconfinedaquifers,UnsteadyRadialFlow,WellHydraulicsincompletelyconfinedaeriallyextensiveaquifer;Theis Method,JacobStraight-LineMethod,Time-recoveryTestandTheisRecoveryMethod,Pumpingtestforaleakyartesianaquifer:Waltonmethod,Hydrologyoflakes,hydrologyofwetlands.		
TOTAL LECTURES		**46 Hours**

Assignments

•Decipheringofhydrogeologicalboundariesonwatertablecontourmaps.

•AnalysisofHydrographs

•Determinationofpermeability.

•GroundwaterqualitystudyusingTrilinear(Hill-Piper),C-Sdiagrams

•Problemsonradialflowtoawellinconfinedandunconfinedaquifers

•Exercisesonstepdrawdowntest

•DeterminationofaquiferparametersusingTheisandJacob'smethods

•Calculationofsaltwaterencroachmentincoastalaquifers

•Electricalresistivitysurveysforaquiferdelineation

•ApplicationofAquachem,Modflow,etc

Books:

1.Fetter,C.W.2001,*AppliedHydrogeology*,PrenticeHallInc.,NJ.,U.S.A.
2.Fitt,C.R.2006.*GroundwaterScience*,AcademicPress.
3.Freeze,R.A.andCherry,J.A.,1979.*Groundwater*,EnglewoodCliffs,NewJersey:Prentice-Hall.
4.Raghunath,H.M.2007,Third.Edition,*GroundWater*,*N*ewageInternationalPublishers,NewDelhi.
5. SchwardandZhang,2003.*FundamentalsofGroundwater*,JohnWilleyandSons

Oceanography and Climetology (TIU-PGL-T213)

Program:M.Sc in Applied Geology	**Year, Semester:** 2nd Yr., 3rd Sem.
Course Title: **Oceanography and Climetology**	**Subject Code:**TIU-PGL-T213
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit: 3**

COURSE OBJECTIVE :

Enable the student to:

1. Understand the physical, chemical, geological, and biological processes governing ocean systems.
2. Analyze atmospheric dynamics, climate patterns, and their interactions with ocean circulation.
3. Interpret oceanographic and climatological data to assess environmental and climatic changes.

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO-1:	Develop comprehensive models of oceanic circulation and climate systems.	K2
CO-2:	Evaluate human impact on coastal ecosystems and marine resource policies.	K2
CO-3:	Analyze seawater chemistry and its biological and physical variations.	K4
CO-4:	Apply marine geological concepts to interpret sedimentation and ocean floor features.	K3
CO-5:	Understand fundamental climate system principles and their oceanic interactions.	K3
CO-6:	Recall natural and anthropogenic climate change factors, including Milankovitch cycles.	K3

COURSE CONTENT :

MODULE 1:	**OCEANIC CURRENT**	**4 Hours**
Oceanic circulation, Oceanic currents – types and controlling factors; **Waves:** Classification and dynamics ; Tides: Types and controlling factors; The equilibrium and dynamic theory of tides		

MODULE 2:	**COASTS AND ESTUARIES**	**4 Hours**
Classifying coasts, features of primary and secondary coasts, coasts formed by biological activities; Beaches and estuaries; Lagoons and wetlands; Human interferences in coastal processes		
MODULE 3:	**SEA WATER CHEMISTRY:**	**4Hours**
Major and minor constituents of sea water and their residence times; Processes controlling the composition of sea water, Dissolved gases in sea water-their sources and sinks; Interrelationships between ocean circulation, primary productivity and chemical composition of the atmosphere and ocean		
MODULE 4:	**MARINE GEOLOGY**	**4 Hours**
Morphological and tectonic domains of the ocean floor; Mid oceanic ridge systems; Hydrothermal vents and seawater — basalt interaction; Modes and rates of sedimentation in the oceans; Nature of deep sea sediments and processes regulating sedimentary composition		
MODULE 5:	**MARINE RESOURCES**	**4 Hours**
Types of marine resources; Physical, energy, biological and non-extractive resources; Laws of the sea, Environmental Concerns; Marine pollution; Pathways of transfer of various pollutants and their fates in the sea		
MODULE 6:	**CLIMATE SYSTEM**	**4 Hours**
. 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		
MODULE 7:	**HEAT BUDGET OF EARTH**	**4 Hours**
Incoming solar radiation, receipt and storage of heat, Heat transformation, Earth's heat budget. Interactions amongst various sources of earth's heat		
MODULE 8:	**ATMOSPHERE – HYDROSPHERE:**	**4 HOUR**
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		
MODULE 9	**RESPONSE OF BIOSPHERE TO EARTH'S CLIMATE:**	**4 HOUR**
Climate Change: natural vs. anthropogenic effects, Humans and climate change, Future perspectives, Brief introduction to archives of climate change, Archive based climate change data from the Indian continent		
MODULE 10	**ORBITAL CYCLICITY AND CLIMATE**	**4 HOUR**
Milankovitch cycles and variability in the climate ,Glacial-interglacial stages, The Last Glacial maximum (LGM) ,Pleistocene Glacial-Interglacial cycles, Younger Dryas , Marine isotope stages ;**Monsoon:** Mechanism of monsoon, Monsoonal variation through time, Factors associated with monsoonal intensity Effects of monsoon, Study of distribution of major climatic regimes of India on map, Distribution of major wind patterns on World map		
TOTAL LECTURES		**40 Hours****

Natural Hazards and their mitigation (TIU-PGL-T215)

Program:M.Sc in Applied Geology	**Year, Semester:** 2nd Yr., 3rd Sem.
Course Title: Natural Hazards and their mitigation	**Subject Code:**TIU-PGL-T215
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit: 3**

COURSE OBJECTIVE :

Enable the student to:

1. Understand the causes, types, and impacts of natural hazards on the environment and society.
2. Analyze hazard assessment techniques and early warning systems for disaster preparedness.
3. Apply mitigation strategies and risk management approaches to reduce hazard vulnerabilities.

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO-1:	Develop disaster response plans incorporating mitigation strategies.	K2
CO-2:	Evaluate disaster management policies and risk reduction strategies.	K2
CO-3:	Analyze geological and atmospheric hazard factors using GIS and remote sensing.	K4
CO-4:	Apply knowledge of hydrospheric hazards to assess and mitigate risks.	K3
CO-5:	Understand principles of disaster management, legislative responsibilities, and capacity building.	K3
CO-6:	Recall hazard classifications and characteristics, including landslides and atmospheric phenomena.	K3

COURSE CONTENT :

MODULE 1:	**CONCEPTSOFDISASTER**	**5Hours**
Typesofdisaster:naturalandmanmade:Cyclone,flood,landslide,landsubsidence,fireandearthquake.Issuesandconcernforvariouscausesofdisasters		
MODULE 2:	**DISASTER MANAGEMENT**	**5 Hours**
Managementissuesrelatedtodisaster;Mitigationthroughcapacitybuilding,legislativeresponsibilitiesofdisastermanagement;disastermapping,assessment,pre-disasterrisk&vulnerabilityreduction,postdisasterrecovery&rehabilitation;disasterrelatedinfrastructure development; Remote-sensingandGISapplicationsinrealtimedisastermonitoring,preventionandrehabilitation.		
MODULE 3:	**THELITHOSPHEREANDRELATEDHAZARDS**	**12Hours**
EarthquakesandFaults,MeasuresofanEarthquake,EarthquakeHazards,EarthquakeControlandPredictio		

n; **Magma:**OriginandTypes,VolcanicProductsandHazards,Monitoring,RiskEvaluation,Prediciton,TectonicsandClimate,MeteoriteImpacts; **AtmosphericHazards:**IntroductiontotheAtmosphere,WaterVapor,Clouds,andPrecipitation,ForcesandAirMotion,WinterStormsI-AirMasses,FrontsandJetStreams,WinterStormsII-EvolutionofCyclonesandAnticyclones,SpringStormsI-AtmosphericStability,SpringStormsII-ThunderstormsandLightning,Spring; StormsIII-HailandFlashFlooding,SpringStormsIV-Tornadoes,SummerStormsI-TropicalWeatherSystems,SummerStormsII-HurricanesandStormSurge Drought,AirPollution		
MODULE 4:	**THEHYDROSPHEREANDRELATEDHAZARDS**	**8 Hours**
LivingontheWaterPlanet,Fluvialhazards-flooding,channelmigration,bankerosion,catchmenterosion.Tsunamis,CoastalHazardsI:SeaLevelchange, CoastalHazardsIl:ShorelinesRetreating		
MODULE 5:	**LANDSLIDES**,	**10 Hours**
Typesofslopefailure,SlopeMassRating(SMR)classification,Causativefactors,LandslideHazardZonation,FactorofSafetyanalysis,Slopestabilizationmeasures.SinkholesandSubsidence; EstuarinePollution,BiologicalPollution:AlienSpeciesandEmergingDiseases,MassExtinction,EvolutionandExtinction		
TOTAL LECTURES		**40 Hours****

Quaternary Geology and Palaeoclimate (TIU-PGL-T217)

Program:M.Sc in Applied Geology	**Year, Semester:** 2nd Yr., 3rd Sem..
Course Title: Quaternary Geology and Palaeoclimate	**Subject Code:**TIU-PGL-T217
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit: 3**

COURSE OBJECTIVE :

Enable the student to:

1. Understand Quaternary geological processes, stratigraphy, and landscape evolution.
2. Analyze paleoenvironmental records to reconstruct past climate changes and glacial-interglacial cycles.
3. Interpret Quaternary geochronology and its implications for climate change and human evolution.

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO-1:	Develop a comprehensive understanding of Quaternary geology and climate systems.	K2
CO-2:	Evaluate Quaternary stratigraphy and paleoclimatic records for historical	K2

	climate insights.	
CO-3:	Analyze dating methods to establish a chronological framework for Quaternary events.	K4
CO-4:	Apply paleoclimatology principles to reconstruct past climate conditions.	K3
CO-5:	Understand flora, fauna, and human evolution during glacial-interglacial cycles.	K3
CO-6:	Recall stratigraphic techniques and their applications in natural hazard assessments.	K3

COURSE CONTENT :

MODULE 1:	**QUATERNARYGEOLOGY:**	**12 Hours**
DefinitionofQuaternary,TheCharacterofQuaternary,DurationoftheQuaternaryanddevelopmentofQuaternarystudies.Quaternarystratigraphy-Oxygenisotopestratigraphy,biostratigraphyandmagneto-stratigraphy, Responseofgeomorphic,neotectonic,activetectonicsandtheirapplicationtonaturalhazardassessment.Quaternarydatingmethods:Radiocarbon,UraniumseriesLuminescence,AminoAcid,Relativedatingmethods.Applicationofpollen,sporesandphytolithsinQuaternarystratigraphy.		
MODULE 2:	**QUATERNARYSTRATIGRAPHYOFLNDIA**	**12 Hours**
Continentalrecords(fluvial,glacial,Aeolian,Paleosolsandduricrust);marinerecords;continentalmarinecorrelation ofQuaternaryrecord. EvolutionofManandStoneAgeculture.Plantandanimallifeinrelationtoglacialandinterglacialcyclesduring Quaternary.		
MODULE 3:	**PALEOCLIMATOLOGY**	**12 Hours**
Introductiontoclimateandclimatesystems,Globalclimatepattern,Climatecontrollingfactors.Globalenergybudget, PlatetectonicsandclimatechangeMilankovitchcycles,AtmosphereandOceaninteractionanditseffectonclimate.An OverviewofPaleo-climaticreconstruction;PleistoceneGlacial-Interglacialcycles;FutureClimate:AnthropogenicactivityanditseffectonGlobalclimate.		
TOTAL LECTURES		**34 Hours**

Reference Books:

1.Bigg,G.,1999OceanandClimate.Springer-Verlag
2.Bradley,F.,2000.Paleoclimatology:ReconstructingClimatesoftheQuaternary.Springer- Verlag.
3.MaherandThompson,2000.QuaternaryClimates,EnvironmentsandMagnetism. CambridgeUniversityPress.
4.Williams,Durnkerley,Decker,KershawandChhappell,1998.QuaternaryEnvironments. WileyandSons

Remote sensing in exploration (TIU-PGL-T219)

Program:M.Sc in Applied Geology	**Year, Semester:** 2nd Yr., 3rd Sem.

Course Title: Remote sensing in exploration	**Subject Code:**TIU-PGL-T219
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit: 3**

COURSE OBJECTIVE :

Enable the student to:

1. Understand the principles of remote sensing and its applications in geological exploration.
2. Analyze satellite imagery and geospatial data for mineral, hydrocarbon, and groundwater exploration.
3. Apply remote sensing techniques for structural mapping, landform analysis, and resource assessment.

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO-1:	Develop innovative approaches to remote sensing applications.	K2
CO-2:	Assess effectiveness of remote sensing platforms for environmental data interpretation.	K2
CO-3:	Analyze interactions of EM radiation with materials and their impact on remote sensing data.	K4
CO-4:	Apply remote sensing techniques for terrain analysis, land-use detection, and hazard assessment.	K3
CO-5:	Understand fundamental concepts of EM spectrum, sensor technologies, and data interpretation.	K3
CO-6:	Recall major satellite programs, aerial photography principles, and practical skills in remote sensing.	K3

COURSE CONTENT :

MODULE 1:	**REMOTE SENSING:**	**6 Hours**
Definition, scope and purpose. Types or classification of Remote Sensing (RS). Digital imagery vs. conventional photography. Different stages or requirements for the successful execution of the remote sensing operation..		
MODULE 2:	**ELECTROMAGNETIC SPECTRUM (EM-SPECTRUM):**	**6 Hours**
Fundamental concepts and theories. Subdivisions of the EM- spectrum. Basic laws governing the behavior of the EM-radiation, and the interrelationships among these laws in view of remote sensing. The common wavelength bands used in RS and their characteristic purposes.		
MODULE 3:	**ENERGY INTERACTION:**	**6 Hours**
Different interactions of energy or radiation with matter in different scales. Role of atmosphere in remote sensing. Concept of atmosphere windows.		
MODULE 4:	**VARIOUS SENSORS**	**6 Hours**
Basic ideas about the working principles of various sensors : Simple cameras, Vidicon cameras, Push broom system using charge-coupled devices (CCDs). Line scanners, Multi-spectral scanners, Microwave		

imaging system (using LASER and RADAR). Thermal infra-red imagers, Spectro-radiometers.		
MODULE 5	**SATELLITE EXPLORATION PROGRAMMES**	**6 Hours**
Basic knowledge about the different satellite exploration programmes of the world and their characteristics (viz. LANDSAT, SEASAT, SPOT, TRS, IKONOS etc.) Introducing satellite images (both Hard- copy and Soft-copy formats)		
MODULE 6	**AERIAL PHOTOGRAPHY**	**6 Hours**
Aerial photography and aerial photographs. Features air-photos, scale, photomosaics, air- photo stereo-pairs, Stereoscopic vision and pseudoscopic vision. Stereoscopic study of air-photos, parallax, vertical exaggeration and its various factors. Hands-on use of mirror and pocket stereoscopes. Ideas about possible sources of errors in aerial photography and/or satellite imagery, Different elements of air-photo (or image) interpretation. Photogeology, Elementary practical exercises on photogeological mapping.		
MODULE 7	**PHOTOGRAMMETRY**	**4 Hours**
Use of parallax bar. Basic idea about how to measure height, area, dip/slope, vertical exaggeration, image distortion etc. from air-photos.		
MODULE 8	**DIGITAL REMOTE SENSING**	**6 Hours**
Pixel and resolution. DN-code. Digital remote sensing images. False colour composite (FCC). Computer assisted (i.e.digital) image processing techniques. Digital classification- unsupervised and supervised. Hands-on training of digital image interpretation using easily available packages and images (PC-mode). Application of RS techniques for terrain analysis (Geomorphological). Land- use detection, litho-mapping, structural mapping, mineral exploration, environmental hazards assessment, groundwater prospecting.		
TOTAL LECTURES		**46 Hours**

Exploration Geophysics (TIU-PGL-T221)_

Program:M.Sc in Applied Geology	**Year, Semester:** 2nd Yr., 3rd Sem.
Course Title: Exploration Geophysics	**Subject Code:**TIU-PGL-T221
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit: 3**

COURSE OBJECTIVE :

Enable the student to:

1. Understand the fundamental principles and methods of geophysical exploration.
2. Analyze subsurface structures using seismic, gravity, magnetic, electrical, and electromagnetic techniques.
3. Apply geophysical data for mineral, hydrocarbon, and groundwater exploration.

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO-1:	Formulate advanced geophysical exploration strategies.	K2
CO-2:	Assess geophysical data accuracy and reliability for subsurface	K2

	characterization.	
CO-3:	Analyze geophysical anomaly maps and seismic data for resource identification.	K4
CO-4:	Apply geophysical methods in field settings for subsurface investigations.	K3
CO-5:	Understand fundamental principles of gravity, magnetic, electrical, and seismic methods.	K3
CO-6:	Recall key concepts of geophysical exploration techniques and well logging.	K3

COURSE CONTENT :

MODULE 1:	**GRAVITYMETHODS:**	**8 Hours**
Figureoftheearth,Gravityanditsvariationoverthesurface,GravityFieldsurveys,Bouguer,FreeairandTopographiccorrectedgravityanomalies.Preparationofgravityanomalymapsandtheirinterpretation.WorkingPrincipleofLacosteRombergandWordenGravitimeter.		
MODULE 2:	**MAGNETICMETHOD:**	**8 Hours**
Geomagneticfieldandbasicmagneticproperties.WorkingprinciplesofFluxgateandProtonprecessionmagnetometer.Fieldsurvey&datareduction,Preparationofmagneticanomalymapsandtheirqualitativeinterpretation,Magneticanomaliesovervarioustypesofbodies.Determinationofdepthfrommagneticanomalies.Introductiontoaeromagneticsurvey		
MODULE 3:	**ELECTRICALMETHOD:**	**8 Hours**
Basicofrockelectricalpropertiesandprinciples,SP,Resistivitymethod:basicprinciples,fieldprocedure,electrodearrays,Interpretationofelectricalprofileandinterpretationofsoundingcurvesfortwoandthreelayeredearthmodel.		
MODULE 4:	**SEISMICMETHOD**	**8 Hours**
Basicofseismicprospecting.Traveltimeexpressionforrefractionandreflectionforsingleandmultipleanddippinginterfaces.Seismicenergysources,detectorsandseismicrecorder,Refractiondatareductionandinterpretation,Applicationofrefractionmethods.CommonDepthPointtechniqueforreflectionsurvey.Positioning&Navigation,Applicationofreflectionmethodforhydrocarbonexploration.Introductionto3Dseismics.		
MODULE 5	**WELLLOGGING**	**8 Hours**
Principleofself-potentialandelectricallogging.Applicationinpetroleumandgroundwaterexploration,Principleofgammaray,densityandneutronlogging.		
TOTAL LECTURES		**40 Hours****

SuggestedReadings:

1.AppliedGeophysics(2ndEdition):W.M.Telford,L.P.GeldartandR.E.Sherrif(2004)CambridgeUniversit

yPress.
2.PrinciplesofAppliedGeophysics:D.S.Parasnis(1997)Chapman&Hall.
3.IntroductiontoGeophysicalProspectingbyMiltonMDobrin&CarlHSavit,4thEdn.(1988)*McGrawHill.4. ExplorationSeismology–R.E.Sheriff,LandP.Geldart,(1995)CambridgeUniversityPress.*

Industrial Tour (TIU-PGL-P211)

Program:M.Sc in Applied Geology	**Year, Semester:** 2nd Yr., 3rd Sem.
Course Title: Industrial Tour	**Subject Code:**TIU-PGL-P211
Contact Hours/Week: 0–0–3 (L–T–P)	**Credit: 6**

Course Objective:

To expose students to geological industries and field operations, enhancing their understanding of applied geology through direct field observation and interaction with professionals.

Course Outcome:

Students will gain practical insights into geological processes, mineral exploration, and industrial applications, bridging academic knowledge with real-world practice.

Semester 4

Fossil fuels and their exploration (TIU-PGL-T200)

Program:M.Sc in Applied Geology	**Year, Semester:** 2nd Yr., 4th Sem.
Course Title: Fossil fuels and their exploration	**Subject Code:**TIU-PGL-T200
Contact Hours/Week: 4–0–0 (L–T–P)	**Credit: 4**

COURSE OBJECTIVE :

Enable the student to:

1. Understand the formation, classification, and global distribution of fossil fuels.
2. Analyze geological, geophysical, and geochemical methods for fossil fuel exploration.
3. Apply exploration techniques for hydrocarbon and coal resource assessment and extraction.

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO-1:	Design innovative exploration strategies for fossil fuels.	K2
CO-2:	Evaluate physical and chemical properties of fossil fuels.	K2
CO-3:	Analyze coal and petroleum formation processes and migration mechanisms.	K4

CO-4:	Apply mining and exploration techniques for fossil fuels.	K3
CO-5:	Understand environmental impacts of fossil fuel extraction and mitigation strategies.	K3
CO-6:	Recall fundamental concepts of fossil fuel composition and exploration.	K3

COURSE CONTENT :

MODULE 1:	**COAL**	**6 Hours**
Origin of Coal, Macroscopic and Microscopic constituents, biochemical and dynamo-chemical changes in coal formation ,concept of macerals and micro lithotypes		
MODULE 2:	**PHYSICAL PROPERTIES OF COAL:**	**8 Hours**
Physical properties and chemical characterization — Proximate and ultimate analysis, Rank and grade of coal, Indian and International classification, Distribution of coal in space and time with special reference to India		
MODULE 3:	**COAL MINING**	**8 Hours**
Methods of mining- opencast and underground mining of coal deposits,sampling, bench mapping, underground mine mapping, preparation of plans and sections, planning, exploration and exploratory mining of surface and underground coal deposits.		
MODULE 4:	**INDUSTRIAL UTILIZATION OF COAL**	**8 Hours**
Industrial utilization of coal, coal petrography, v-step analysis, coal carbonization, coal blending, coke and char formation , oil window, coal oxidation, shale gas, coal bed methane ,Environmental impacts in mining industries.		
MODULE 5	**PETROLEUM**	**8 Hours**
Composition of petroleum and natural gas, Kerogen and their types ,Origin of petroleum, Migration of natural hydrocarbons: Types and mechanisms, Petroleum system – source rock, reservoir rock, cap rocks; Traps : Structural, stratigraphic and combination traps		
MODULE 6	**PETROLEUM EXPLORATION**	4 HOURS
Geological and Geophysical survey, Oil well drilling, Source rock Analysis , Well logging , Reserve estimation; Petroleum production; Petroliferous Basins of India Gas Hydrates: Structure, Occurrence, exploration		
MODULE 7	**NUCLEAR FUEL**	4 HOURS
Minerology, Geochemistry and mode of occurrence of radioactive minerals ; Techniques of detection and measurements of radioactivity and exploration of radioactive mineral deposits ; Distribution of radioactive minerals in India ; Radwaste disposal — geological constrains		
TOTAL LECTURES		**46 Hours****

SUGGESTED READINGS:

1. Chandra D. (2007). Chandra's Textbook on applied coal petrology. Jijnasa Publishing House.

2. Shelly R. C. (2014). Elements of Petroleum geology: Third Edition, Academic Press
3. Bjorlykke, K. (1989). Sedimentology and petroleum geology. Springer-Verlag.
4. Bastia, R., & Radhakrishna, M. (2012). Basin evolution and petroleum prospectivity of the continental margins of India (Vol. 59). Newnes

Fossil fuels Practical (TIU-PGL-L200)

Program:M.Sc in Applied Geology	**Year, Semester:** 2nd Yr., 4th Sem.
Course Title: Fossil fuels and their exploration	**Subject Code:**TIU-PGL-T200
Contact Hours/Week: 0–0–3 (L–T–P)	**Credit: 3**

COURSE OBJECTIVE :

Enable the student to:

1. Identify and classify coal, petroleum, and natural gas samples based on physical and chemical properties.
2. Analyze microscopic and geochemical characteristics of fossil fuels using laboratory techniques.
3. Interpret exploration data for assessing fossil fuel potential and reservoir characterization.

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO-1:	Develop skills in identifying and classifying coal hand specimens.	K2
CO-2:	Estimate coal reserves using resource assessment methodologies.	K2
CO-3:	Correlate geological sections and identify hydrocarbon prospects.	K4
CO-4:	Construct panel and fence diagrams for geological visualization.	K3
CO-5:	Analyze practical results to assess fossil fuel resources.	K3
CO-6:	Apply geological mapping and reserve estimation skills.	K3

COURSE CONTENT :

MODULE 1:	**COAL IN HAND SPECIMEN**	**8Hours**
Study of hand specimens of coal		
MODULE 2:	**COAL UNDER MICROSCOPE AND RESERVE ESTIMATION**	**8Hours**
Maceral identification and Reserve estimation of coal		
MODULE 3:	**HYDROCARBON PROSPECT**	**8Hours**
Section correlation and identification of hydrocarbon prospect		
TOTAL LECTURES		**24 Hours**

Dissertation paper (TIU-PGL-P202)

Program:M.Sc in Applied Geology	**Year, Semester:** 2nd Yr., 4th Sem.
Course Title: Dissertation paper	**Subject Code:**TIU-PGL-P202
Contact Hours/Week: 0–0–3 (L–T–P)	**Credit: 12**

Course Objective:

To develop students' research skills by guiding them through independent investigation on a geological topic, promoting critical thinking and academic writing.

Course Outcome:

Students will demonstrate the ability to conduct independent research, analyze data, and present findings in a structured dissertation format, adhering to scientific standards.

Dissertation Seminar (TIU-PGL-D202)

Program:M.Sc in Applied Geology	**Year, Semester:** 2nd Yr., 4th Sem.
Course Title: Dissertation Seminar	**Subject Code:**TIU-PGL-D202
Contact Hours/Week: 0–0–3 (L–T–P)	**Credit: 3**

Course Objective:

To enhance students' presentation and communication skills by providing a platform to present their dissertation research and receive constructive feedback.

Course Outcome:
Students will effectively present and defend their research work, demonstrating clarity in scientific communication and the ability to engage in academic discussions.

Non-thesis Seminar (TIU-PGL-D204)

Program:M.Sc in Applied Geology	**Year, Semester:** 2nd Yr., 4th Sem.
Course Title: Non-thesis Seminar	**Subject Code:**TIU-PGL-D204
Contact Hours/Week: 0–0–3 (L–T–P)	**Credit: 3**

Course Objective:

To develop students' abilities to review, analyze, and present current topics in geology, encouraging critical thinking and academic discourse.

Course Outcome:

Students will demonstrate proficiency in researching scientific literature, synthesizing information, and delivering clear, well-structured presentations on geological themes.