SYLLABUS OF M.SC. IN

APPLIED GEOLOGY

JIS UNIVERSITY,
81, Nilgunj Road, Agarpara
Kolkata -700109

M.Sc. EARTH SCIENCES SYLLABUS

(M.Sc in APPLIED GEOLOGY)

FIRST SEMESTER

	SUBJECT CODE	SUBJECT NAME	L	T	P	CREDIT	CONTACT HOURS
	MGL 101	Structural Geology	3	0	0	3	3
	MGL 102	Sedimentology and Basin analysis	3	0	0	3	3
	MGL 103	Hydrogeology	3	0	0	3	3
	MGL 104	Palaeontology	3	0	0	3	3
	MGL 105	Remote Sensing and GIS	3	0	0	3	3
	MGL 191	Structural Geology Practical	0	0	3	2	3
	MGL 192	Sedimentology and Basin analysis Practical	0	0	3	2	3
	MGL 194	Palaeontology Practical	0	0	3	2	3
	MGL 195	Remote Sensing and GIS Practical	0	0	3	2	3
	BGL 181	Project & Seminar				1	2
	TOTAL					24	29

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SECOND SEMESTER

	SUBJECT CODE	SUBJECT NAME	L	T	P	CREDIT	CONTACT HOURS
	MGL 201	Mineral Science	3	0	0	3	3
	MGL 202	Geochemistry and Isotope Geology	3	0	0	3	3
	MGL 203	Stratigraphy	3	0	0	3	3
	MGL 204	Geophysics	3	0	0	3	3
	MGL 205	Geomathematics and Geostatistics	3	0	0	3	3
	MGL 292	Geochemistry and Isotope Geology Practical	0	0	3	2	3
	MGL 206	Field Geology				2	
	MGL 281	Project & Seminar				1	2
	MGL 282	Skill Development				1	1
		Total				21	21

M.Sc. EARTH SCIENCES SYLLABUS

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THIRD SEMESTER

	SUBJECT CODE	SUBJECT NAME	L	T	P	CREDIT	CONTACT HOURS
	MGL 301	Igneous Petrology	3	0	0	3	3
	MGL 302	Ore Geology and Mineral Exploration	3	0	0	3	3
	MGL 303	Energy Resources	3	0	0	3	3
	MGL 304	Environmental Geology and Geotechnical Engineering	3	0	0	3	3
	MGL 305	Geodynamics	3	0	0	3	3
	MGL 391	Igneous Petrology Practical	0	0	3	2	3
	MGL 392	Ore Geology and Mineral Exploration Practical	0	0	3	2	3
	MGL 394	Environmental Geology and Geotechnical Engineering Practical	0	0	3	2	3
	MGL 381	Project & Seminar				1	2
		Total				22	

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FOURTH SEMESTER

	SUBJECT CODE	SUBJECT NAME	L	T	P	CREDIT	CONTACT HOURS
	MGL 401	Metamorphic Petrology	4	0	0	4	4
	MGL 402	Marine Geoscience	4	0	0	4	4
	MGL 403	Palaeoclimatology	4	0	0	4	4
	MGL 491	Metamorphic Petrology Practical	3	1	0	4	4
	MGL 492	Marine Geoscience Practical	0	0	3	2	3
	MGL 404	Dissertation/ Industrial training	0	0	3	2	3
	MGL 481	Grand Viva				1	2
	MGL 482	Skill Development	0	0	0	1	1
		Total				22	25

SYLLABUS FOR M.Sc., APPLIED GEOLOGY

JIS University

D E T A I L E D S Y L L A B U S

SEMESTER 1

MGL 101: Structural Geology THEORY

Concept of continuum mechanics; Stress and behaviour of rocks under stress; Strain and analysis of strain; Role of fluid in deformation; Progressive deformation; Rheology: Stress –Strain curves for elastic, viscous and plastic; the relationships among stress, rheology and strain, poro-elasticity.

Fracture mechanics; dynamics of faulting and jointing.

Mechanism of folding and superposed folding; Interpretations of ductile structures: foliation, lineation, boudinage; Structural analysis of deformed terrain.

Grain scale deformation: Mechanism and its manifestation in rock microstructure.

Shear Zones, Grain scale deformation mechanism and its manifestation in microstructure: Solid State Diffusion Creep. Granular flow and Superplasticity.

MGL 191: Structural Geology PRACTICAL

Solution of structural problems by stereographic projection (in combination with other graphical methods, when necessary). Graphical solutions of simple problems of finite deformation. Structural interpretation of geological maps. Study of mesoscopic structures from hand specimens.

MGL 102: Sedimentology and Basin Analysis THEORY

Fluid mechanics basic concepts and its relation to sedimentary bed forms and structures.

Sediment entrainment and transportation.

Bernoulli’s theorem of fluid flow.

Concept of Rayleigh-Taylor and Kelvin-Helmbotz instability in relation to sedimentology.

Sediment gravity flows-classification and transport mechanisms and depositional products.

Concepts of sedimentary environments, its control and classification.

Facies analysis: Principles, facies models and environmental reconstructions of principal siliciclastic environments in continental, transitional and marine realm. Carbonate depositional system.

Siliciclastics: Origin , Diagenesis, Provenance and tectonic reconstructions.

Carbonates: controls of carbonate deposition, constituents of limestone, its mineralogy and diagenesis. Dolomite and dolomitisation.

Definition, mineralogy, classifications and occurrence of volcanoclastics, chert and evaporite.

Basin analysis: Classification and mechanics of formation of major basin types, subsidence analysis, fill character and modelling techniques.

Seismic and sequence stratigraphy.

Definition & scope of Sequence Stratigraphy. Tectonic control on eustatic sea-level changes. Allostratigraphy. Cyclostratigraphy. Eventstratigraphy. Sea-level changes & offlap, onlap, downlap surfaces.Parasequences. Lowstand, transgressive & highstand system tracts. Types of sand bodies. Facies & Facies changes. Depositional sequences & facies control. Facies models for fluvial, intertidal, deltaic, barrier islands & deep ocean systems,

MGL 192: Sedimentology and Basin Analysis PRACTICAL

Description and interpretation of sedimentary structures in hand specimens.

Palaeocurrent analysis, granulometric analysis of sediments and interpretation.

Granulometric analysis and interpretation of siliciclastic and carbonate rocks under microscope.

Geochemical data interpretation .

Facies correlation from lithologs.

MGL 103: Hydrogeology THEORY

Hydrological Cycle and processes: systems concept of hydrological cycle, precipitation, evaporation and transpiration, run off, baseflow, infiltration, global and Indian distribution of water resource.

Groundwater Hydrology: origin of groundwater, subsurface profile of groundwater, classification of rocks with respect to water bearing characterizes, geomorphic and geologic occurrence and flow controls of groundwater, groundwater provinces in India; Aquifers - unconfined, confined, and semi-confined; water table and piezometric surface; genetic classification of groundwater.

Hydrological Characterizes of Aquifer: porosity, void ration, permeability, transmissivity, storativity, specific yield, specific retention, diffusivity, velocity; elasticity of confined aquifers.
Laws of groundwater movement: Bernoulli's equation, Darcy's Law, Laplace equation, flow nets, steady and unsteady unidirectional flow; radial flow.

Groundwater Management: recharge and discharge areas; safe yield and overdraft; land subsidence; rain water harvesting and artificial recharge; consumptive and conjunctive use of water; conservation of water; water shed management.

MGL 104: Palaeontology THEORY

Taxonomy and Systematics – alpha taxonomy; phylogenetic systematics; species problem in paleontology; bio, chrono, and morphospecies.

Morphodynamics – growth and function; functional morphology; methods of morphodynamic analysis

History of Life – diversity of life, Precambrian life, Cambrian explosion and metazoan radiation, Burges Shale fauna, Phanerozoic diversity

Ecology and paleoecology – definition and spatio-temporal scales; ecologic principles; niche; limiting factors in ecology and paleoecology; interaction with abiotic and biotic components (predation, competition, biological bulldozing); bivalve-brachiopod interaction; food web complexity and ecologic interactions through time; ecologic parameters (richness, evenness, and diversity); paleobiogeography; application of stable isotope; macroecology (patterns, processes, Phanerozoic megatrends)

Taphonomy – definition; taphonomic filters; Phanerozoic trends (record versus bias)

Stratigraphy: biozones and biostratigraphic classification; bio- and chronostratigraphic applications of fossils in Phanerozoic

Evolution and Macroevolution – definition and spatio-temporal scales; theories; patterns; processes; Phanerozoic spatio-temporal megatrends

Mass extinction and Conservation – major mass extinction episodes (cause and effect); the sixth mass extinction; conservation paleobiology

Critical evaluation of major mega-invertebrate groups - Echinoidea, Mollusca (Bivalves, Gastropods, Ammonites), Brachiopoda, Trilobita, Graptolithina

Study of major micro-invertebrate groups - foraminifera, cocolithophores, ostracoda, pteropoda, calcareous algae, radiolaria, conodonts, Bryozoa

Vertebrate paleontology – terrestrial diversity; major evolutionary events; patterns and processes of evolution of horses, elephants, and hominids; Indian record of Mesozoic reptiles dinosaurs, and fossil fishes.

Paleobotany - plant diversity through time; flowering versus non-flowering plants; palynology as a tool; Gondwana flora and importance

Ichnofossils and their applications

MGL 104: Palaeontology PRACTICAL

Cladistics – construction of cladogram and identification of ancestral and shared derived characters

Applied Micropaleontology - Study of major groups of micro-invertebrates under microscope; Determination of relative age and depth of deposition from larger and smaller foraminiferal fossil assemblages respectively; elementary problems on stratigraphy; preservation, collection and processing of samples and method of study

Functional morphology study - bivalves, brachiopods, gastropods, echinoids, ammonites, microfossils

Ecology and paleoecology – study of ontogenetic change in shell shape and size in bivalves; quantification of predation intensity using subsamples; paleoecologic reconstruction using microfossil assemblages

MGL 105: Remote Sensing and GIS THEORY

Basic concepts of remote sensing: definition, scope, advantages, and limitations; EMR, EM spectrum, atmospheric windows; Interaction with target, specular and Lambertian (diffuse) reflectors; black, white, and grey (natural) bodies; spectral reflectance curves; ideal and real RS systems; platforms (vehicles with ladders, cranes, scaffoldings, tall buildings, kites, pigeons, balloons, aircrafts, space crafts, satellites) and censors (film and digital aerial cameras, optical mechanical scanners, CCD linear arrays, radiometers, spectrometers, altimeters, depth meters, distance meters, RADAR, TV); types of resolutions; passive and active RS systems.

Indian space program from INCOSPAR (1962) till date.

Introductory photogrammetry: flight planning, scale, overlap, sidelap, relief displacement, radial line methods and instruments; stereovision, stereoscopy, stereometry, vertical exaggeration, satellite cartography: orientation, triangulation, stereomodel compilation, DPM/DEM

Photographs: terrestrial and aerial-vertical and oblique (low and high), images: PAN, multispectral, FCC, hyperspectral, thermal, RADAR, LIDAR, ground trothing, GPS, DGPS.

Visual image interpretation: elements, keys, generation of maps and profiles/sections.

Digital image processing and interpretation

GIS: definitions, scope, concepts, advantages and limitations; spatial and attribute data, raster and vector data models; topology; surface models: point, lattice, contour, TIN, DEM, DBMS; procedures; software.

Geological and geoenvironmental applications of geoinformatics

Procurement and security of aerial photographs and satellite images.

MGL 195: Remote Sensing and GIS PRACTICAL

Stereo tests; interpretation of single air photos and single band/PAN satellite images including border/annotation lines information (metadata)

Interpretation of stereo pairs of vertical air photos under pocket and mirror stereoscopes; interpretation of MSS and FCC images; visual and digital interpretation of digital images; use of GIS and image processing software

Georeferencing, supervised and unsupervised classification of natural fractures
Preparation of DEM

SEMESTER 2

MGL 201 Mineralogy

Principles of X- ray powder methods, Bragg Equation and its application, different types of bonding, co-ordination principle and co-ordination numbers,

X –ray camera: diffractrogram, procedure for identification of minerals from x-ray powder diagram, use of internal standards.

Brief outline of EPMA, XRD and SEM.

Feldspar Group : internal structure, Alkali Feldspar, Plagioclase Feldspar and ternary feldspar, proportion of Al- occupancy in T sites in $KAlSi_3O_8$; degree of ordering, 2V as an indicator of ordering in K- feldspar, polymorphism of $NaAlSi_3O_8$, ordering paths in albite, structural states of plagioclase, obliquity of K- feldspar.

Nepheline: Constitution of Nepheline, compositional non- stoichiometry, nephelines of volcanic and plutonic /metamorphic origin, nature of Al- Si ordering, vacant site from chemical analysis of nepheline.

Brief idea on the internal structure of Pyroxene, Amphibole and Mica (with relevant classification schemes) and site- occupancy of cations.

Olivine: Brief structural characters, anti-ordering in olivine, olivine- spinel transitions and its geodynamic significance.

Spinel Group: Different types of spinels and their internal structures.

Silica group of Minerals.

Phase transition in the mantle

Fundamentals of Crystal Field Theory, concept of stabilization energy, Application of crystal field Theory in determining mineral structure.

MGL 202 Geochemistry and Isotope Geology THEORY

Branches of Geochemistry; earth in relation to Solar system and Universe.

Meteorites: definition, age, importance of study; classification and its basis, mineralogical characteristics and contrast with terrestrial mineralogy, broad chemical characteristics, brief outline on origin.

Nucleosynthesis; cosmic abundance of elements; Geochemical classification of elements; average chemical composition of continental crust, oceanic crust, entire crust, mantle, core and entire earth; methods of computation of these average compositions; Geochemical differentiation of primordial earth.

Chemical Geodynamics, Chemical evidence for mantle heterogeneity, Lead paradox, DUPAL anomaly, mode of occurrence of trace elements in igneous rocks; behavior of trace elements during magmatic crystallization.

General chemical characteristics of sedimentary rocks; role of ionic potential; hydrogen ion concentration and oxidation- reduction potential in sedimentation; Eh- pH diagrams of Mn- H_2O systems and Fe-H_2O systems with and without CO_2.

The atmosphere: structure and composition of atmosphere; geochemical cycle of nitrogen. The evolution of atmosphere; constancy of atmospheric composition; Formation and destruction of ozone layer, Ozone hole.

The Hydrosphere: distribution of water on the earth; average compositions of sea water, river water and ground water; gains and losses of the oceans, balance of the dissolved matter in sea water, origin and evolution of sea water, chemical evolution of ground water, lithological control on the quality of groundwater.

The Biosphere: the concept of biosphere, mass of the biosphere, Geochemical cycle of carbon.

Isotope Geology: Stable and radioactive isotopes, cosmogenic isotopes, stable and Radiogenic isotope geochemistry, principles and methods of radioactive dating; Application of isotopes in Geology.

MGL 292 Geochemistry and Isotope Geology PRACTICAL

Determination of igneous rock suite using variation diagrams.

Trace element modeling in fractional crystallization and partial melting processes.

Chemical discrimination between ortho- and para metamorphites.

Drawing of isochron and determination of MSWD from isotopic data

Isotopic ratio plots to bracket petrogenesis of igneous rocks.

Determination of slow and fast vibration directions of minerals, scheme of pleochroism.

Determination of anorthite content of plagioclase by symmetric extinction angle method.

Determination of optic sign of uniaxial and biaxial minerals, estimation of 2V with the help of interference figures.

R.I. determination of isotropic and anisotropic minerals by liquid immersion method.

Determination of cell- edge parameters of isometric crystals

Calculation of cation proportion, formulae of rock- forming minerals using excel spreadsheet.

Laboratory demonstration of EPMA, XRD and SEM.

MGL 203: Stratigraphy

General principles: Building-up of a regional stratigraphy; boundary problem

Precambrian Stratigraphy:
Difficulties in the application of Laws of Stratigraphy in older rocks, especially the Archean rocks. Additional tools, at times the only tools: geochemistry, isotope dating, and geodynamic modelling.

Well preserved rock record of the early Earth in most of the continents – the general character of Archean rock record. The major components: greenstone belts, and the high grade terrane.

General characters of greenstone belts- petrology, geochemistry and tectonics, the controversy and confusion over the name 'greenstone' belt.

High grade terranes and their main constituents Tonalite- Trondhjemite- Granodiorite (TTG). Their typical characters - mainly geochemical. Differences between post-Archean granitoids and the TTGs. The geodynamic significance of TTG – melting of oceanic basalts – the tectonic scenario subduction zone, oceanic plateau etc. Use of trace elements Ta-Nb. Brief overview of importance of zircon (U-Pb, initial Hf, continental vs oceanic), Sm-Nd and Pb-Pb systematic, and Geochron.

Sanukitoids – the rock marking the Archean – Proterozoic boundary.

Some rock restricted to Archean e.g. BIF, Komatiite, some variety of tholeiite, and herringbone carbonate. Most emphasis on Komatiite to understand the thermal structure of Earth in the Archean.

The oldest preserved crustal material –its significance using U-Pb systematics, and oxygen isotope results.

TTG, plate tectonics in the early Earth, and birth of continents.

Phanerozoic Stratigraphy

Phanerozoic successions at different parts of India at their interrelationship in terms of plate tectonics (supercontinental cycle, paleolatitudes, etc.), eustasy, and paleoenvironment.

Milankovitch cycle and rock record.

Sequence Stratigraphy

Ichnology & its application in facies analysis. Ecostratigraphic trends in Sequence Stratigrsphy. Application of Sequence Stratigraphy in hydrocarbon indicators. Reservoir, Modeling, occurrence of natural gas hydrates. Gas hydrates associated with bottom simulating reflectors (BSF). In situ Identification of marine gas hydrates. Physico-chemical properties of gas hydrates & application to world-margin stability & climatic changes.

MGL 204 Geophysics THEORY

Seismology and Interior structure of the Earth : Elastic wave theory, Snell's Law, the ray parameter and theory of seismic waves, Earthquake seismology, Internal structure of the earth (crust, mantle and core) – Gravity: Gravitational fields of the earth and anomalies, Geoid and figures of the Earth, Isostasy and structure of the crust – Geomagnetism : Earth's magnetic field, Magnetic behavior of rocks, Palaeomagnetism and its applications – Thermal and Electrical properties of the solid Earth : Source of heat, Heat flow mechanism in crust, mantle and core, Geoelectricity – Physical and chemical processes in the mantle and core : Mineralogical transformations in the mantle and core, Mantle rheology, Convection processes in the mantle and core – Geodynamics : State of stress in the lithosphere, Plate tectonics and continental drift, Principle tectonic settings in the earth's crust : extensional, compressional, transformal, transpressional, Phanerozoic rift tectonics, Tectonics of Peninsular and Extrapeninsular India, Neotectonics and their implications in geomorphology.

Basic principles of Geophysics. Detailed knowledge of different types of geophysics methods involving gravity, magnetic & seismic Gravity methods: introduction, Gravity potential and field due to different simple bodies and structures. Field procedure. Bouguer gravity anomalies, interpretations & field-cases Magnetic methods: introduction, magnetic properties of rocks, geomagnetic field, field procedure, measurement of magnetic anomalies, interpretation. Electrical method: Introduction, Self potential, earth resistivity, different arrays, profiling & sounding techniques, interpretation & field cases. Induced polarization. Telluric & electromagnetic methods. Seismic method: introduction, refraction methods, layered earth refraction studies, hidden layer problem, correction, instruments, field procedures, interpretation. Various well-logging techniques.

MGL 205: Geomathematics and Geostatistics

Scientific methods & some basic concept of statistics:

Sample- Universe: Measurement- scale & error; Models; Measurement of variability; Probability

Population distribution- binomial, normal, Poisson.

Statistical inferences- errors in judgment

Confidence Intervals.

Small sampling theory- Chi-square, Student's t, Snedecor's F tests

Non –parametric tests- Kolmogorov-Smirnov.

ANOVA-correlation & linear regression
Analysis of sequence of data: Markov chain and embedded Markov chain, Runs test; Auto correlation ; Cross correlation; Cross association. Geostatistics: Semivariograms; Kriging – punctual; Calculation of drift. Spectral analysis and filters. Analysis of multivariate data: Multiple regression: Discriminant functions; Cluster analysis; R- and Q- mode factor analysis.

MGL 206: Field Geology

Field training to students in different geological terranes including mine-visits.

SEMESTER 3

MGL 301: Igneous Petrology THEORY

Study of important two, three and four component systems at low and high pressures (wet and dry) and their application in describing textures and petrogenesis of various rock- types.

Trace element modeling for igneous petrogenesis. Concept of activation energy and viscosity on melt equilibria.

Magma genesis and emplacement; relation of magma generation and global plate tectonics.

Mantle melting, melt-mantle interaction and magmatic evolution in various geodynamic settings.

Mid Ocean Ridge Basalt (MORB) and its global correlation.

Large Igneous Provinces, mantle plumes and related magmatism

Brief idea on physical volcanology, criteria for identification of several volcanic flows, distinct zones within a flow, common volcanic structures, pyroclasts.

General idea on layered complex, salient features of Stillwater, Skaergaard and Bushveld complexes.

Carbonatite and ophiolites: genesis, emplacement and classification

MGL 391: Igneous Petrology PRACTICAL

Study of hand specimens of representative igneous rocks.

Study of thin sections of different plutonic, volcanic and restitic igneous rocks with emphasis to understand relevant petrogenesis.

Calculation of CIPW norms of silica-oversaturated and undersaturated igneous rocks, use of those normative data to interpret crystallization history.

Use of biaxial variation diagram to quantify magmatic crystallization.

MGL 302: Ore Geology and Mineral Exploration THEORY

Processes of formation of mineral deposits, changing perception of ore genesis.

Modern sea floor deposits, their genetic implications and ancient analogies.

Important metallic, non-metallic and atomic mineral deposits of India and of neighboring countries.

Ore texture, sequence of temperature of formation, ore solutions, complexing and ore deposition

Mineral resources- time, space, and dynamic controls, resource management concept, mineral economics, present status of resources, resource development and future sources.

National mineral policy; classification of mineral deposits, discovery types, stages of exploration: reconnaissance permits, large area prospecting, prospecting license, mining lease, mineral deposits and host rocks

Geological exploration: surface signatures like stratigraphy, weathering (gossan), structures (fold, fault, lineament, shear, breccia), old mining activities (India)

Geochemical exploration: soil, rock, stream sediments, hydrogeochemical, biogeochemical, geobotanical, atmogeochemical, and electrogeochemical

Drilling technology: percussion, diamond, reverse circulation, air core, wireline, BH deviation survey

Sampling: pitting, trenching, channel, chip, drill core/ non-core, bulk/muck/grab/car/stack sampling; reduction, accuracy and challenges; QCR, QA analysis

Reserve estimation: cut-off, ROM, cross section, long section, level plan and inverse distance; classification of reserves/resources (conventional, USGS, UNFC, and JORC)

Mining terminologies: surface and underground (soft and hard rock)

Beneficiation: general beneficiation techniques of Pb, Zn, and Cu sulfides, Fe ores

Exploration rick management and parameters for success

Hazards of mineral industries

Exploration case studies

MGL 392: Ore Geology and Mineral Exploration PRACTICAL

Ore microscopy- mineral identification, mineral association, broad textural features. Paragenesis

Study of minerals in hand specimens.

Chemical mineralogy- determination of iron & calcium contents in iron ore & limestone respectively.

Study of resource maps. Problems on ore reserve estimations from surface and sub surface sampling data.

MGL 303: Energy Resources

Coal

Physical, chemical and optional properties of coal. Changes in properties of coal with metamorphism. Classification of coal – ASTM, Mott, Seyler, and Indian. Petrology and Palynology of coal. Conditions of formation of coal and coal seams. Inorganic mineral matters; Sulphur and Phosphorous in coal. Correlation of coal seams. Estimation and categorization of resources. Industrial utilization of coal. Coal resources of India. Environmental management of coal based industries.

Petroleum

Composition and physical characteristics of petroleum, fuels and other by-products of petroleum. Source rock types and examples. Reservoir properties: porosity and permeability: effects of geological agents on reservoir properties: clastic, carbonate, and other reservoir rocks; Indian examples. Origin of petroleum- organic matter types and maturation process. Migration of petroleum-primary and secondary. Entrapment of petroleum –seal rocks; structural traps; stratigraphic traps; unconventional petroleum accumulations. Reservoir conditions reservoir/fluid relationship, reservoir energy and drive mechanisms; Reservoir delineations. Sedimentary basin dynamics-classifications of basins ; pre-requisites for hydrocarbon accumulations; petroleum resources and reserves; global distribution patterns. Petroliferous basins of India; exploration and exploitation of petroleum; utilization of natural gas. Plate tectonics and its implication in Petroleum, future thrust areas. Sequence stratigraphy and its implications in Petroleum exploration. Application of logging and seismic techniques in Petroleum exploration. Geochemical prospecting in petroleum exploration. Unconventional sources of energy

Nuclear Energy

Geochemistry of U and Th, geochemical abundance of radioactivity in crustal rocks, important minerals, types of U and Th deposits, nuclear raw material resources of India, usage of nuclear energy. Potential alternative (renewable) energy sources such as Geothermal, solar, wind, tidal, biomass, etc.

MGL 304: Environmental Geology and Geotechnical Engineering THEORY

Introduction to earth processes and natural hazards

Geotechnical properties of soils and rocks

Slope stability and mass wasting; landslides and related hazards

Earthquake; hazard assessment and mitigation

Engineering structures: dam, tunnels, roads, bridges; selection of sites for construction

Earth's processes affecting engineering structures

Environmental impact assessment: air, soil, groundwater, flora-fauna, and ecosystem; waste management of energy resources; pollution of environmental and its mitigation

The environmental impact of mining, beneficiation, and smelting

Climate change and global warming

Role of man in environment (Anthropocene and Neo-mass extinction)

MGL 394: Environmental Geology and Geotechnical Engineering PRACTICAL

Determination of void ratio, degree of saturation, amount of consolidation, compaction in soil

Analysis of discontinuities in rocks for estimating stability of surface

Stability of mass, RQD calculation

Determination of pore water pressure, seepage pressure, drainage capacity

Preparation and interpretation of engineering geologic maps including face maps, subsurface maps and diagrams, hazard zonation maps, etc.

Analysis of soil stability

Testing and description of aggregate samples

Sampling and analysis of water and soil

Preparation of project report on environmental impacts of any one of the following: mining, river valley projects, thermal power plants, industrial projects.

MGL 305: Geodynamics

Brief history of development of tectonic concepts since the eighteenth century.

Geophysical techniques in tectonics; gravity anomalies and heat flow measurements.

Geometry of plate motions including vector solutions. Processes and structures associated with different types of plate boundaries.

Tectonism along continental margins and continental rifts. Driving force(s) of plate tectonics.

Mantle plumes. Surface expressions and importance in lithospheric tectonism.

Tectonic evolution of the Himalayan- Alpine chains.

The Appalachians and the Andes.

SEMESTER 4

MGL401: Metamorphic Petrology THEORY

Fundamentals of thermodynamics of used in Geological system.

Phase rule, metamorphic reactions and phase equilibria in metamorphic rocks.

Metamorphic phase equilibria calculation: geothermometry and geobarometry.

Phase diagrams, Schreinemakers bundle and petrogenetic grid for metamorphic assemblages in various grades of metamorphism.

Graphical representation of various mineral assemblages in different P-T conditions.

Heat flow and metamorphism: Paired Metamorphic belt, Schematic diagrams to illustrate the origin of paired metamorphic belts.

Time-scale of metamorphism and implications on thermal history. Temperature-time histories in metamorphic rocks. Metamorphic P-T-t paths and tectonic evolution.

Thermal modeling and metamorphic facies series. Different types of metamorphic facies and their tectonic setting.

Ocean floor metamorphism

Impact metamorphism

Metamorphic conditions in HT and HP metamorphism.

UHT and UHP metamorphism

Migmatite and granite Petrogenesis.

MGL 491: Metamorphic Petrology PRACTICAL

Description metamorphic rocks under microscope and their identification.

Identification of equilibrium mineral assemblages and chemogrpahic relation.

Interpretation of metamorphic textures with reference to time relations between the phases of deformation and recrystallization of minerals such as chloritoid, garnet, staurolite, kyanite and magnetite.

Identification of metamorphic facies from a set of thin sections of metamorphic rocks.

Graphical representation of the metamorphic assemblages and model metamorphic reactions in ACF, AKF and AFM diagrams.

Estimation of Pressure and Temperature from important models of Geothermobarometry.

Introduction to relevant software for computational thermodynamic modeling of metamorphic rocks.

MGL 402: Marine Geosciences THEORY

Origin and morphology of ocean basins and ocean margins. Marine stratigraphy. Correlation and Chronology. Depth profile and ocean floor topography, continental margins, mid-oceanic ridge, island arcs and trenches. Tectonic history of ocean basins, opening and closing of seaways and their impact on deep- sea sediments. Ocean circulation, nearshore geological processes and the continental shelf. Sources and composition of marine sediments, pelagic and hemi pelagic, the sediment cycle, classification of marine sediment types, oceanic microfossils. Geological effects of bottom currents: erosion, transportation and deposition. Global sea level rise-past and future; tectonically-driven and ice-driven sea level fluctuations.

MGL 492: Marine Geosciences PRACTICAL

Processing of marine sediments: deep sea and costal. Study of various types of marine sediments under stereoscopic binocular microscopes. Analysis of marine organic matter and particle size using TOC and Particle Size Analyzer. Analysis of marine biofacies and sedimentary facies.

MGL 403: Palaeoclimatology

Elements of climate, global climatic variation, Paleoclimatic reconstruction, techniques & sources of paleoclimatic formation. Air-sea interaction, El-Nino-southern oscillation, Walker

circulation, Coriolis force, Rossby currents, Mobile polar highs. Dating methods: introduction and overview. Ice cores and marine record. Global dynamics of ice- sheets, late Cenozoic ice ages. High and low latitude teleconnections. Millennial scale variations & paleoclimate models. Milankovitch theory of paleoclimate. Paleomonsoons, human responses to paleoclimate-changes. The climate of the future.

MGL 404: Industrial Training / Dissertation

Compulsory training to each student for 2-3 weeks in a reputed industry/ corporate house

MGL 481: Grand Viva

Assessment of fundamental knowledge on different branches of geological sciences