

Syllabus
M.Sc. (Geology)



**Department of Geology
Ravenshaw University,
Cuttack-753003**

M. Sc Geology Syllabus (2012-2013 Admission Batch)

Semester I				
Paper No	Paper code	Paper	Marks	Credits
I	MG 1.1	Physical Geology	50	4
II	MG 1.2	Global Tectonics and Structural Geology	50	4
III	MG 1.3	Advanced Mineralogy	50	4
IV	MG 1.4	Geochemistry	50	4
V (Lab.)	MG 1.5	Mineralogy and Structural Geology	100	8
Semester II				
VI	MG 2.6	Igneous and Metamorphic Petrology	50	4
VII	MG 2.7	Sedimentary Geology	50	4
VIII	MG 2.8	Stratigraphy and Quaternary Geology	50	4
IX	MG 2.9	Micropalaeontology and Oceanography	50	4
X (Lab.)	MG 2.10	Petrology	100	8
Semester III				
XI	MG 3.11	Ore Geology	50	4
XII	MG 3.12	Geoinformatics	50	4
XIII	MG.3.13	Hydrology and River Engineering	50	4
XIV	MG 3.14	Environmental Geology*	50	4
XV (Lab.)	MG.3.15	Hydrology and Remote Sensing	100	8
Semester IV				
XVI	MG.4.16	Isotope Geology and Instrumentation	50	4
XVII	MG 4.17	Coal Geology	50	4
XVIII	MG.4.18	Petroleum Geology and Pipeline Engineering	50	4
XIX	MG 4.19	Energy Resources and Climate Change	50	4
XX	MG.4.20	Project and seminar presentation	100	8
			1200	96

*Inter disciplinary paper

**M.Sc. GEOLOGY
FIRST SEMESTER**

Theory MG 1.1	Physical Geology	Full Mark: 50	4 Credits
Unit I:	<i>Understanding the earth dynamics-</i> Exploring solar system, Processes of sedimentation, igneous and metamorphic activity; Geologic Time Scale, Reconstructing Geologic history through relative dating.		
Unit II:	<i>Physical geology-</i> Origin of earth, Exploring the interior of Earth with seismic waves (Crust, Mantle, Core, Discontinuities)		
Unit III:	<i>Volcanism and Earthquakes-</i> Causes and formation of volcano, Volcanic products, Types of volcano, Volcanic topography, Types of seismic waves, Causes of earth quake, Classification of earthquakes, Magnitude of earthquake		
Unit IV:	<i>Geomorphology-</i> Weathering, Erosion, Geological actions of River, Wind, Underground water, Glacier, Drainage systems and patterns.		
MG 1.2	Global Tectonics and Structural Geology	Full Mark: 50	4 Credits
Unit I:	<i>Geotectonics-</i> Plate Tectonics (The mosaic of plates, Rates of plate motion, The driving mechanism of plate tectonics; Types of plate boundary-convergent, divergent, Conservative), Continental drift (Geometric, Palaeontologic, Stratigraphic, Palaeomagnetic etc. evidences)		
Unit II:	<i>Geodynamics-</i> Theory of Isostasy, Geomagnetism and Sea floor spreading, Mid-oceanic ridges, island arcs, Canyaons and fans of the sea.		
Unit III:	<i>Rock deformation, orientation and fold-</i> Elements of deformation, relation between stress and strain, Mechanism of Folding and Faulting, geological significance of unconformities		
Unit IV	<i>Lineation, foliation and joint-</i> Lineation and foliation and their types and relation to major structures; Joint— geometry and classification of joints and their geological significance.		
MG 1.3	Advanced Mineralogy	Full Mark :50	4 Credits
Unit I:	<i>X- ray mineralogy-</i> Nature of x-rays; interaction of x-rays and atoms; interference of x-ray waves; diffraction by a row of atoms, planes of atoms; cell parameters, d-values, intensity of diffraction, single crystal diffraction, powder diffraction and identification of minerals from power diffraction pattern		
Unit II:	<i>Silicate Minerals-</i> Structure of silicate minerals. Study of structure, chemistry, physical and optical character of following rock forming silicate mineral groups (Olivine, Garnet, Pyroxene, Amphibole, Mica, Feldspar, and Quartz).		
Unit III:	<i>Non-silicates and Gemstones-</i> Carbonates, Evaporites, Sulphates, Phosphates, Gemstones		
Unit IV:	<i>Mineral Chemistry-</i> Unit cells, parameters and crystallographic axes, points lines and planes in crystal, Miller indices, zones and zone axis, ionic radii, coordination number, crystal irregularities, atomic substitution		

SECOND SEMESTER

Theory

MG 2.6

Igneous and Metamorphic Petrology Full Mark: 50 4 Credits

Unit I: *Introductory Igneous Petrology*- Texture of Igneous Rocks, Bowen's Reaction Principle, Differentiation and Assimilation, Magmatism and Tectonics, IUGS Classification of Igneous Rocks

Unit II: *Petrography and Petrogenesis*- Petrography and Petrogenesis of Granite, Pegmatite, Basalt, Andesite, Ultrabasics, Anorthosite, Alkaline rocks, Carbonatite, Kimberlite

Unit III: *Metamorphic Petrology*- Types and agents of metamorphism, Metamorphic Zones, Grade and facies, ACF & AKF diagrams, Phase rule, Metasomatism, Metamorphic differentiation. Paired metamorphic belt,

Unit IV: *Petrography*- Regional and contact metamorphism of pelites, arenites, carbonates and igneous rocks. Petrogenetic aspects of various rock suites of India like Gneisses, Schist, Quartzite, Slate, Marble, Khondalite, & Charnockite, Migmatites

MG 2.7

Sedimentary Geology Full Mark: 50 4 Credits

Unit I: *Fundamentals of Sedimentary Petrology*- Texture & Structure of Sedimentary Rocks, Diagenesis, Heavy Minerals and their significance, Classification of sedimentary rocks, Sedimentary environment

Unit II: *Sedimentary Petrography*- Genetic classification of sandstones and limestones, petrography of shale, conglomerate and breccia

Unit III: *Applied Sedimentology*-Tectonics and sedimentation, cyclicity of sediments, Mechanical analysis of rocks, Sedimentary facies, study of provenance, palaeogeographic and palaeoenvironment reconstruction

Unit IV: *Sequence Stratigraphy and Basin Analysis* – Concept and principles of sequence stratigraphy, Mechanism of sedimentary basin formation; Basin Stratigraphy, sedimentary basins of India

MG 2.8

Stratigraphy and Quaternary Geology Full Mark :50 4 Credits

Unit I: *Principles of stratigraphy*- Principle of Stratigraphy, Stratigraphic correlation, Standard stratigraphic time scale and their Indian equivalence, Code of Stratigraphic Nomenclature, Stratigraphy and geology of Orissa

Unit II: *Pre-Cambrian Geology* General character, Stratigraphy, structure, lithology and economic resources of Dharwar, Singhbhum, Cuddapah, Vindhyan

Unit III: *Palaeozoic and Mesozoic Stratigraphy*- General character, Stratigraphy, structure, lithology, economic resources and fossil contents Gondwana Supergroup, Triassic of Spiti, Jurassic of Kutch, Cretaceous of Trichinopoly

Unit IV: *Cenozoic Stratigraphy*- General character, Stratigraphy, structure, lithology, economic resources and fossil content of type areas of Tertiary of Assam and Siwalik, Deccan Trap, Quaternary landforms

MG 2.9 Micropalaeontology and Ocenography Full Mark :50 4 Credits

Unit I: ***Foraminifera and Ostracods-*** Objective of micropalaeontology, microfossil groups; Foraminifera (test morphology, life style, food, symbiosis, life cycle, wall structure and composition, Chamber growth and development, Evolution of Foraminifera, General classification, Foraminiferal bioenvironmental indicators, Palaeoecological significance of Foraminifera, Distribution of planktonic foraminifera; Ostracods (morphology of the ostracod carapace, ontogeny, articulation, distribution and ecology of ostracods, ecological variables, applications of ostracods; classification, geological history of Ostracod)

Unit II: ***Coccolithophores and Diatom-***Coccolithophores (Introduction; Coccolith morphology; Coccolith Life-Style, Ecology and Reproduction; Coccoliths and Sedimentation; Geologic history of coccoliths); Diatoms (Introduction; living diatom, Cell contents of living diatom; Structure and morphology of a diatom [Diatom frustule; diatom symmetry planes; diatom ornamentation); Taxonomy; Growth and reproduction; Diatom distribution and ecology; Geologic record and evolution; Applications and importance of diatoms

Unit III: ***Palaeobotany and Palynology-*** Palynology (introduction, history of Palynology; method of study, applications), Gondwana flora (Glossopteris flora, Dicroidium flora, Ptillophyllum flora) and their significance.

Unit IV: ***Marine Geology-***Relief of ocean floor (Continental Shelf, Continental Slope, Continental Rise and Abyssal Plain), Marine sediments and their classification (Lithogenous, Biogenous, Hydrogenous, Cosmogenous), Sea floor mineral resources

**Practical
MG 2.10**

Petrology

Full Mark: 100

8 Credits

THIRD SEMESTER

Theory

MG 3.11

Ore Geology

Full Mark: 50

4Credits

- Unit I: *Ore genesis and ore deposits of India-* Ores and ore minerals, magmatic processes of mineralization, porphyry, skarn, hydrothermal mineralization, fluid inclusion. Mineralogy, Mode of Occurrence, Distribution, Origin and uses of Iron, Manganese, Bauxite, Chromite, Beach sands
- Unit II: *Mineral Exploration-* Geological, Geochemical & Geobotanical methods of prospecting, Exploration of mineral resources using Electrical, Magnetic, Gravity, Seismic and Radioactive methods
- Unit III: *Mineral Economics-* Methods of Ore reserve estimation, United Nations Framework Classification of Ore Reserve Estimation, Sampling, Quality Control, and National Mineral Policy
- Unit IV: *Mineral Engineering-* Comminution, Crushing and operational features of Jaw crusher, Roll Crushers, Grinding -Ball Mill, Rod Mill, Size analysis, Gravity Separation, Jigging, Dense Media Separation, Tabling, Froth floatation, Magnetic and Electrostatic Separation

MG 3.12

Geoinformatics

Full Mark: 50

4Credits

- Unit I: *Concepts and Foundations of Remote sensing-* Energy sources and radiation principles, Energy interaction in the atmosphere, Energy interactions with earth surface features, An ideal remote sensing system, a real remote sensing system.
- Unit II: *Orbital characteristics of remote sensing satellites-* Types of platforms and sensors; resolution of sensors- spatial, spectral, radiometric and temporal. Remote sensing satellites in operation: LANDSAT, SPOT, IRS, their sensor characteristics and application.
- Unit III: *Thermal infrared radiation-* properties; Thermal radiation principles- radiant vs Kinetic temperature, Black body radiation, Interaction of thermal radiation with terrain elements, Fundamentals of microwave remote sensing, SLAR: system components, spatial resolution, Synthetic Aperture Radar (SAR).
- Unit IV: *GIS-* Objectives of Geographical Information Systems, components of GIS, conceptual models of spatial information- raster and vector data models, advantages and disadvantages of raster and vector data models, non spatial information and concept of database, database structures-hierarchical, network and relational, important features of relational database structure- primary and foreign keys.

MG 3.13 Hydrology and River Engineering Full Mark :50 4 Credits

Unit II: **Water Quality-** Quality of groundwater and quality criteria for different uses, Economic dimensions of water use, Monitoring of Drinking water quality, Augmentation and conservation of water resources, Waste water reuse systems, Organic and inorganic contamination of groundwater and their remedial measures

Unit II: **Groundwater Recharge and Rainwater Harvesting-** Methods of Groundwater exploration, Artificial groundwater recharge, Rain water harvesting, Groundwater provinces of Orissa and India, saline water intrusion

Unit III: **River Engineering, morphology and sediment transport-** Purposes of river engineering, River morphology, Physical characteristics, Channel configuration, meandering, bends, alluvial fans, deltas, banks erosions, channel geometry, Importance of bank erodability.

Unit IV: **Planning and Management-** Planning and design, Surveys for river engineering, measurement of stream flow and sediments, dredging, Levees and associated flood control works

MG 3.14 Environmental Geology Full Mark :50 4 Credits

Unit I: **Natural disasters and management-** Drought, Flood, Cyclone, Tornado, Thunder storm

Unit II: **Managing Geohazards-** Earthquake, Land slide, Tsunami, Inundation of Coastlines

Unit III: **Environmental Management-** Environmental Impact of Mining, Disposal of industrial and radioactive waste, Mineral Conservation, Sustainable Mining,

Unit IV: **Environmental Act-** Salient features of The Water Act, 1974 (Area of Jurisdiction, Constitution of Pollution Control Boards, Power and Function of Central and State Boards); The Air Act, 1981 (Area of Jurisdiction, Constitution of Pollution Control Boards, Power and Function of Central and State Boards); The Water Cess Act, 1977, The Environment Protection Act, 1986 (Powers of Central Government)

MG 3.15 Hydrology, Remote Sensing and Ore Geology Full Mark :100 8 Credits

FOURTH SEMESTER

Theory

MG 4.16 **Isotope Geology and Instrumentation Full Mark :50** **4 Credits**

Unit I: *Isotope Geochemistry*-Stable isotope: Oxygen isotope, Sulphur isotope, Carbon isotope, Hydrogen isotope, Strontium Isotope

Unit II: *Radioisotopes*: Uranium-Thorium-Lead Method, Potassium-Argon method, Rubidium-Strontium method, Radiocarbon dating

Unit III: *Instruments for Physical Characterisation*- Need for Mineral Characterisation, Characterisation of Minerals using Optical Microscopy, Electron Microscopy, EDAX, EPMA

Unit IV: *Instruments for Chemical Characterisation* - Classical methods of geochemical analysis, High precision analytical methods using XRF, NAA, Ion Chromatograph, AAS, ICP-MS

MG 4.17 **Coal Geology** **Full Mark :50** **4 Credits**

Unit I: *Coal Petrology*- Definition, Formation of coal, varieties of coal, Origin and Indian distribution of coal, stratigraphy of coal measures

Unit II: *Coal petrography*- Rank of coal, Coal Analysis; Proximate analysis, Ultimate analysis, Microscopic constituents of coal

Unit III: *Industrial application of coal*- Coal carbonization, Hydrogenation, Liquefaction and gasification, underground coal gasification, Coal bed Methane, coal mining methods

Unit IV: *Coal hazards and mitigation measures*- Environmental impact of coal mining, acid mine drainage, mine subsidence, groundwater inundation, spontaneous combustion of coal, environmental impact of coal based power plants, disposal of coal ash, carbon sequestration.

MG 4.18 Petroleum Geology and Pipe Line Engineering Full Mark : 50 4 Credits

Unit I: *Fundamentals of petroleum geology* -Origin, migration and entrapment of natural hydrocarbons, Mode of occurrence of petroleum, seepages, mud volcanoes, oil shale or kerogen shale, structural, stratigraphic and mixed traps;

Unit II: *Petroleum Exploration and Petroleum Reservoir-* Methods of Petroleum Exploration, Nomenclature of reservoir; fragmental, chemical, miscellaneous reservoir rocks, well logs, marine and non-marine reservoir rocks, pore space, classification and origin of pore space, reservoir fluids; water, oil and gas; Reservoir Pressure: Measurement of pressure, sources of pressure, anomalous pressure, capillary pressure, Reservoir temperature; measurement of temperature, sources and effects of heat, Interface phenomenon, reservoir energy.

Unit III: *Pipeline Engineering and Maintenance of pipelines* - Engineering Considerations, equipment and methods required for successful planning, design, construction, operation. Methods and apparatus for the maintenance of oil pipelines. Corrosion Control on Oil Pipelines

Unit IV: *Pipeline risk analysis:* Pipeline risk analysis, major accident prevention documents, pipeline integrity management systems, risk to environment and public (individual and societal risk); Causes of pipeline failure, Consequences of failure, Fire and Explosions, Gas Dispersion

MG 4.19 Energy Resources and Climate Change Full Mark : 50 4 Credits

Unit I: *Geothermal Energy and Nuclear Energy-* Origin and nature of geothermal energy, Geothermal fields of India, utilization of geothermal resources in India, Nuclear reactions (Nuclear fission and Nuclear fusion), Concept of Nuclear Reactor

Unit II: *Solar and Wind Energy-* Use of solar energy, Direct and indirect harnessing of solar energy, Solar heating devices: Solar cooker (Boxtype solar cooker and Spherical reflector type of solar cooker), solar water heater, solar cells, Utilization of wind energy by different wind devices (wind mill pump; wind flour mill)

Unit III: *Elements of Climatology* - Thermal Structure & Composition of Atmosphere; Elements of Climate and weather; Jet stream and its influence on world weather; Air Mass, their classification and influence on world weather; Fronts (Front classification).

Unit IV: *Climate Change-* Glacial periods, sea-level rise, effects of sea level rise, Rise of carbon dioxide in the atmosphere, green house gases, green house effect and global warming, Desertification

MG 4.20 Project and Seminar Presentation Full Mark:100 8 Credits