SYLLABUS

(2019-20-21)

MASTER OF SCIENCE IN GEOLOGY

(An Integrated Course of Four Semesters)

DEPARTMENT OF GEOLOGY

GOVT.NAGARJUNA P.G. COLLEGE OF SCIENCE

RAIPUR (CHHATTISGARH)

DEPARTMENT OF GEOLOGY

GOVT. N.P.G. COLLEGE OF SCIENCE, RAIPUR

SCHEME OF EXAMINATION (2019-20) -M.Sc.

- It is proposed that M.Sc. Geology shall consist of four semesters as given in the table named scheme of examination attached herewith (page nos 02 to 05).

- Semester first and second and accordingly third and fourth shall have four theory papers of 80 marks each with for marks of sessionals, resultantly it will be of each 100 marks. An as per UGC guidelines all these four papers will of four credits. These four papers of four hundred marks and sixteen credits in total will have two practical's namely lab course-I and lab course-II of hundred marks each and three credits each thereof which comes as six credits for practicals in total. This configuration is proposed for all the four semesters.

- In the semester second lab course-II and semester four lab course-II student will have to submit a project report and project report/dissertation respectively on the topic allotted to him by the supervisor.

- The sessional will be allotted on the basis of seminar, sessionals, field work or other assignment given.

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SCHEME OF EXAMINATION

M. Sc. Ist Semester

S. No.	Name of the Paper	Marks Allotted				Practical	Credit
		Theory	Sessional	Total	Credit		
1	Mineralogy, Mineral Optics & Crystallography	80	20	100	04	Lab Course I 100 Marks	03
2	Structural Geology	80	20	100	04		
3	Principles of Stratigraphy and Indian Geology	80	20	100	04	Lab Course II 100 Marks	03
4	Palaeontology	80	20	100	04		
Total Marks with total credits				**400**	**16**	**200**	**06**

Name & Signature

H.O.D.

External Subject Experts-

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Departmental members -

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Representative from Industry

Student Member

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SCHEME OF EXAMINATION

M. Sc. IInd Semester

S. No.	Name of the Paper	Marks Allotted				Practical	Credit
		Theory	Sessional	Total	Credit		
1	Igneous and Metamorphic Petrology	80	20	100	04	Lab Course I 100 Marks	03
2	Sedimentary Petrology and Crustal Evolution	80	20	100	04		
3	Geodynamics and Geomorphology	80	20	100	04	Lab Course II 100 Marks	03
4	Photogeology, Remote Sensing and GIS	80	20	100	04		
Total Marks with total credits				**400**	**16**	**200**	**06**

Note: -Lab course II will consist of submission of a project report on the topic allotted to student by the supervisor.

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SCHEME OF EXAMINATION

M. Sc. IIIrd Semester

S. No.	Name of the Paper	Marks Allotted				Practical	Credit
		Theory	Sessional	Total	Credit		
1	Hydrogeology	80	20	100	04	Lab Course I 100 Marks	03
2	Engineering Geology and Geotechnical Investigation	80	20	100	04		
3	Mining Geology and Environmental Geology	80	20	100	04	Lab Course II 100 Marks	03
4	Mineral Exploration	80	20	100	04		
Total Marks with total credits				**400**	**16**	**200**	**06**

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SCHEME OF EXAMINATION

M. Sc. IVth Semester

S. No.	Name of the Paper	Marks Allotted				Practical	Credit
		Theory	Sessional	Total	Credit		
1	Economic Geology – I (Processes)	80	20	100	04	Lab Course I 100 Marks	03
2	Economic Geology – II (Deposits)	80	20	100	04		
3	Chhattisgarh : Geology, mineral resources and their industrial application	80	20	100	04	Lab Course II 100 Marks	03
4	Mining Legislation and Mineral Resources Development	80	20	100	04		
Total Marks with total credits				**400**	**16**	**200**	**06**

Note: **-**Lab course II will consist of submission of a project report/dissertation on the topic allotted to student by the supervisor.

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M.Sc.GEOLOGY

SEMESTER-I
PAPER-I

MINERALOGY, MINERAL OPTICS AND CRYSTALLOGRAPHY

UNIT-I

1.1 Minerals-Definition and classification, Physical Properties of minerals.

1.2 Structures of Silicates, Electrical, Magnetic Properties of minerals.

1.3 Luminescence, Thermal & Radioactive Properties of minerals.

1.4 Polymorphism, Psuedomorphism.

UNIT-II

Study of the following rock forming silicate mineral groups covering Structure, chemistry, physical properties, optical properties & Para genesis of

2.1 Feldspars, Feldspathoid,

2.2 Quartz & Garnet.

2.3 Pyroxenes, Amphiboles,

2.4 Micas, Olivines.

UNIT-III

Study of the following rock forming minerals groups covering structure, chemistry, Physical & optical properties & Para genesis of

3.1 Epidote, chloride, Alumino silicates.

3.2 Staurolite, Cordierite, Talc &chloritoides.

3.3 Study of common oxides, carbonates &Sulphate mineral groups.

3.4 Study of common phosphate, Sulphide& Halide mineral groups.

UNIT-IV

4.1 General principles of optics, Polarization of light, double refraction.

4.2 Interference phenomenon, Isotropic & Anisotropic minerals.

4.3 Petrological microscope, important optical properties of minerals.

4.4 Optical accessory & their use. Uniaxial & biaxial indicatrix & interference figures.

UNIT-V

5.1 Definition of Crystal, Crystal elements, Symmetry, laws of crystallography.

5.2 Common holohedral, hemihedral & hemimorphic form. Parameter &indices.

5.3 Symmetry charaters& forms of normal classes of –Cubic, Tetragonal, hexagonal,Orthorhombic, monoclinic & triclinic systems.Twinning in crystals, Spherical, Gnomonic & stereographic projections.

Note : there will be three section in each paper and each section will cover all the units. Section -A with 10 multiple choice/objective question of 1 mark each without internal choice. Section-B with five short answer type question of 4 marks each with internal choice and Section-C with five long answer type question of 10 marks each with internal choice.

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M.Sc.GEOLOGY

SEMESTER-I
PAPER-II

STRUCTURAL GEOLOGY

UNIT-I

1.1 Rock deformation, concept of Stress & Strain, their relationship.

1.2 Factors controlling deformation Type of Stress &Strain,Stress& Strain ellipsoid.

1.3 Homogeneous & inhomogeneous strain, Finite & Infinitesimal Strain, Strain markers(Measurement of Strain in deformed rocks) Progressive deformation, Top & bottom Criteria.

1.4 Unconformity-types & recognition in field & on geological map .Outlier and Inlier.

UNIT-II

2.1 Fold: definition, elements, classification (Geometric& Genetic),

2.2 Mechanics of development of folds, Super imposed folds

2.3 Recognition of folds in field and on geological map.

2.4 Effects of folds on outcrops, causes of folding.

UNIT-III

3.1 Definition, elements, classification of faults,

3.2 Recognition of faults, causes & mechanism of faulting (with reference to principal stress orientation)

3.3 Effects of faulting on the outcrops, Nappe, klippe, and tectonic windows.

3.4 Difference between fault and unconformity.

UNIT-IV

4.1 Geometric & Genetic classification and importance of Joints,

4.2 Lineation:- definition, types, and their relation to major structures,

4.3 Foliation:- definition & types, and their relation to major structures

4.4 Rock cleavage and schistosity, their relation to major structures.

UNIT-V

5.1 Stereographic projection and their use in structural analysis.

5.2 Signification and limitation of pie and Beta diagram.

5.3 Tectonite:- definition and types. Concept of petrofabric analysis,

5.4 Types of fabric, fabric elements and interpretation of petrofabric data.

Note : there will be three section in each paper and each section will cover all the units. Section -A with 10 multiple choice/objective question of 1 mark each without internal choice. Section-B with five short answer type question of 4 marks each with internal choice and Section-C with five long answer type question of 10 marks each with internal choice.

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Lab Course-I
(Paper I and II M.Sc. Semester I)

(A)

- Megascopic and microscopic study of common rock forming minerals.
- Determination of paleochroic scheme, anorthite content of plagioclase feldspar, estimation of briefergence.
- Determination of order of interference colour and sign of elongation.
- Study of interference figures and determination of optic sign.
- Study of holohedral and hemihedral, hemimorphic and alitriomorphic forms of all crystal system.
- Stereographic projection.

(B)

- Concept on line & plane, altitude of line & plane, dip & strike their measurements.
- Stereographic projection: problems in angular relationship- True dip, apparent dip, Plunge & Rock of the intersection of plane, Beta and Pi diagrams.
- Study of minor structure in Hand specimens.
- Preparation and interpretation of Geological maps- for inclined strata, folds, faults & unconformity.
- Three point problems.
- Application of software- altimeter, Geoclino, my GPS coordinate and other available.

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M.Sc.GEOLOGY

SEMESTER-I

PAPER-III

STRATIGRAPHY AND INDIAN GEOLOGY

UNIT-I

1.1 Stratigraphic principles and Scales for Classification.

1.2 Units of Stratigraphy-Litho Bio and Chrono Stratigraphic units.

1.3 Correlation.

1.4 Correlation in Indian Subcontinent.

1.5 Correlation of rock units of Chhattisgarh with other units of Country

UNIT-II

2.1 Evolution of Lithosphere.

2.2 Chief Divisions of Indian Subcontinent and Their economic Character and Physiographic Character.

2.3 Correlation and Economic Importance of Archeans of Peninsular and Extra Peninsular India.

2.4 Geological Time Scale.

UNIT-III

3.1 Stratigraphy and Correlation of mobile belts and Proterozoic Sedimentry basins of India.

3.2 Classification, Correlation and economic importance of Dharwar Super Group.

3.3 Cuddapah Super Group and Correlation with its other equivalent.

3.4 Vindhayan Super Group and Correlaton with other equivalents.

3.5 Chhattisgarh, Indravati and Khairagarh Group of rocks and Study of their Correlation and economic Importance.

UNIT-IV

4.1 Palaeozoic formation of extra peninsular region, its Correlation and Classification.

4.2 Detail Study of Mesozoic of India.

4.3 Gondwana Super group detail study on their Classification, Correlation and Economic Importance.

4.4 Jurassic rocks in extra peninsular India.

4.5 Detail Study of Deccan traps, Intratrappean and Infratrappeans.

UNIT-V

5.1 Evolution of Man, Plant and Animal Life.

5.2 Stratigraphic units in India and their Economic Importance.

5.3 Stratigraphic units of Chhattisgarh and their economic Importance.

5.4 Importance and other studies of Palaeoclimate and Palaeogeography in Stratigraphy.

5.5 Boundary Problem with Special reference to Indian Stratigraphy.

Note : there will be three section in each paper and each section will cover all the units. Section -A with 10 multiple choice/objective question of 1 mark each without internal choice. Section-B with five short answer type question of 4 marks each with internal choice and Section-C with five long answer type question of 10 marks each with internal choice.

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M.Sc.GEOLOGY

SEMESTER-I

PAPER-IV

PALAEONTOLOGY

UNIT-I

1.1 Definition of fossils and mode of preservation, their application in age determination, Correlation, Palaeoclimatology, Palaeobiogeography and Palaeoecology.

1.2 Modes and theories of organic evolution, concept of bathymetric distribution of animals, migration. Mass Extinction and their causes.

1.3 Outline classification of organisms.

1.4 Morphology, Classification, evolutionary trends and geologic and geographic distribution of Brachiopods.

UNIT-II

2.1 Morphology, Classification , evolutionary trends and geologic, geographic distribution of

2.2 Pelecypoda(Lamellibranchia)

2.3 Gastropoda

2.4 Cephalopoda.

2.5 Trilobites.

UNIT-III

3.1 Morphology, Classification, evolutionary trends and geologic history of Echinoids, Graptolites and Rugose Corals.

3.2 Elementary idea about Vertebrates origin &evolution.

3.3 Evolutionary history of Horse & Elephant.

3.4 Evolutionary history of Man.

UNIT-IV

4.1 Siwalik mammalian fauna.

4.2 General idea about plant evolution through geologic ages.

4.3 Fossil flora of Gondwana Group and Tertiary formation of India.

4.4 Definition and Scope of micropalaeontology, types of microfossils.

UNIT-V

5.1 Techniques in micropalaentology.

5.2 Use of microfossils in Stratigraphic correlation and age determination.

5.3 Use of microfossils in interpretation of sea floor tectonism,hydro carbon exploration.

5.4 Oxygen and Carbon isotope Studies of microfossils and their use in palaeoenvironmental and palaeoocenographic Studies.

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Lab Course-II
(Paper III and IV M.Sc. Semester I)

(A)

- Study of stratigraphic rocks from important geological formation of India.
- Plotting of important stratigraphic formation of world and India.
- Exercise related to stratigraphic correlation.

(B)

- Study of typical vertebrate and invertebrate fossils from different Indian stratigraphic horizons.
- Study of plant fossils of Gondwana formation

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M.Sc.GEOLOGY

SEMESTER-II

PAPER-I

IGNEOUS & METAMORPHIC PETROLOGY

UNIT-I

1.1 Principles and general concept of petrology, petrography & petrogenesis.

1.2 Various forms, structures and textures of igneous rocks & their significance in petrogenesis.

1.3 Phase equilibria of unicomponent, Binary (mixed & Eutectic), Ternary (Ab-An-Dio, for Diopside-Silica) Silicate system.

1.4 Petrographic Province.

UNIT-II

2.1 Magma, Definition, Composition, Charateristics, Factors causing diversity in igneous rocks-Differentiation, Assimilation.

2.2 Origin & evolution of magma, magmatism related to plate tectonics.

2.3 Classification of Igneous rocks important chemical, mineralogical, textural CIPW & IUGS classification.

2.4 Reaction Principles and Bowen's reaction Series.

UNIT-III

3.1 Petrography, Petrogenesis & Indian occurrences of Granite, alkaline rocks.

3.2 Monominerlic rocks (Dunite, Aurthorite)

3.3 Basalt, Andesite, Spillite, Lamprophyre.

3.4 Ultramafic rocks, carbonatite, pegmatite, Kimberlite.

UNIT-IV

4.1 Metamorphism: Defition, Agents, Types of metamorphis.

4.2 Structure & texture of metamorphic rocks, metamorphic grades, Zones.

4.3 Metamorphic Facies, classification of metamorphic rocks.

4.4 Retrograde metamorphism.Metasometism and their types.

UNIT-V

5.1 Regional and Thermal metamorphism of mafic, ultramafic rocks, pelitic sediments, and impure calcareous rocks.

5.2 Graphic representation of metamorphic mineral assemblages, ACF, AKF, and AFM, diagrams.

5.3 Paired metamorphic Belts.

5.4 Study of important metamorphic rocks- Granulite, Charnockite, Eclogite, migmatites, Khondalite, Gondites.

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M.Sc.GEOLOGY

SEMESTER-II

PAPER-II

SEDIMENTARY PETROLOGY AND CRUSTAL EVOLUTION

UNIT-I

1.1 Sedimentary Rock, Processes of sedimentation. Mineral stability, Quartz, Felspar and heavy mineral as Province indicator.

1.2 Classification of Sedimentary Rocks; Rudaceous rocks Conglomerate and Breccia and their classification.

1.3 Arenaceous rock, Dot's Classification of Sandstone, Argillaceous Sedimentary rocks (lutaceous), their composition and environment of deposition.

1.4 Folks and Dunhams Classification of Limestone.

UNIT-II

2.1 Textural analysis of sediments, Grain size measurements Udden-Wentworth and Krumbin Phi scale.

2.2 rain Porosity and Permeability. Graphical representation statistical treatment and geological significance.

2.3 Petrogenesis of arkoses, greywacke and quartz arenites.

2.4 Evaporite and Volcanoclastic sediments. Dolomite and Process of Dolomitisation.

UNIT-III

3.1 Sedimentary structures: Mechanical, Chemical and Organosedimentary structures and their significance in top and bottom criteria.

3.2 Paleocurrents and basin analysis.

3.3 Diagenesis of sandstone and carbonate rocks changes in mineralogy, fabric and chemistry.

3.4 Application of Trace, REE and stable isotope geochemistry in sedimentalogical interpretations.

UNIT-IV

4.1 Sedimentary facies, Depositional environments, Marine, Transitional, Continental,

4.2 Types of delta, Recognition of ancient Delta.Stratigraphy and Sedimentation, Walthers law, Sequence stratigraphy,

4.3 Basin analysis, sedimentary chemistry, Basin evolution and tectonics.

4.4 Introduction to clay mineralogy. Classification, Origin and economic importance.

UNIT-V

5.1 Development of Proterozoic sedimentary basins of India within the Cratons.

5.2 Anatomy of Orogenic belts and formation of mountain roots.

5.3 Life in Pre Cambrians, Pre Cambrian- Cambrian boundary with special reference to India. Relation of sedimentary basins with Plate tectonic.

5.4 Greater Indian continental plate during Proterozoic and Palaeozoic.

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External Subject Experts-

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Departmental members -

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Lab Course-I
(A)

- Megascopic identification & description of Igneous & Metamorphic rocks.
- Study of textures & Structures of Igneous & Metamorphic rocks.
- Microscopic Identification of igneous & metamorphic rocks.
- Plotting the geographic distribution of igneous & metamorphic rock types in outline map of India.
- C.I.P.W. norm calculation.
- Construction of variation diagram.
- Construction of ACF & AKF diagram.
- Application of MVPM software

(B)

- Megascopy of clastic sedimentary rocks (conglomerates, breccias, sandstones and shales) and non clastic sedimentary rocks (limestones, fossilifrous limestones including stromatolitic limestones and dolomites).
- Microscopy of clastic and non- clastic rocks as given above.
- Estimation of sphericity and roundness of grains.
- Identification of sedimentary structures and interpretation of depositional environments.
- Construction and interpretation of rose diagrams using palaeocurrent data.
- Interpretation of texture, structures, based on line drawing.

(C)

- Study of geomorphological models
- Identifications of various types of drainage pattern
- Morphometric analysis : bifurcation ratio, number of stream,length of stream, stream frequency , drainage density, basin area etc.

- Earthquake belt of India and world
- Volcanic belt of world

(D)

- Studyofareal photograph (stereo pair) with the help of stereoscope
- Study of land set imageries, identification of forest, water bodies, lineament and other geological structure
- Various notation of imageries

Books Recommended:

1. Introduction to Sedimentology- S.M. Sengupta.
2. Origin of Sedimentary Rocks, Blatt, H., Middleton, G.V. and Murray, R.C.
3. Sedimentary Structures, Collins, J.D., and Thompson, D.B.
4. Palaeocurrents and Basin analysis By Potter, P.E., &Petijohn, F. J.
5. A Practical Approach to Sedimentology, George Allen and Unwin, London.
6. Practical Manual of Sedimentology By Lindholm., R.
7. Principles of Basin Analysis, Mail Spriinger-Verlag.
8. Sedimentary Rocks (3rd Ed.), Pettijohn; F.J. (1975).
9. Carbonate Sedimentology by M.E. Tucker,
10. Principles of Sedimentology by Friedman and Sanders.

Name & Signature
H.O.D.
External Subject Experts-
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Departmental members -
1.

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M.Sc.GEOLOGY

SEMESTER-II
PAPER-III

GEODYNAMICS AND GEOMORPHOLOGY

UNIT-I

1.1 Earth and Solar System, Origin of the earth.

1.2 Interior of the earth. Age of the earth.

1.3 Palaeomegnetism, Continental drift,

1.4 Polar wandering, sea floor spreading.

UNIT-II

2.1 Plate Tectonics- Characteristics of Boundaries- Concordant, Discordant.

2.2 Island Arc, Subduction Zone, oceanic Trenches.

2.3 Mid Oceanic Ridge, Triple Junction. Transform fault.

2.4 Convection current, continent-continent collision. Continent -ocean collision.

UNIT-III

3.1 Volcanoes- Their form & structure,Types,Volcanic products, volcanic belts of the world.

3.2 Earthquake- Types of earthquake waves,its measurement.

3.3 Richter and Marcali scale, earthquake zones of India and Major Earthquake belts of theworld.

3.4 Geosynclines- Classification and evolution.

UNIT-IV

4.1 Principles of Geomorphology, Theories of Geomorphology.

4.2 Landforms in relation to climate, rock type, structure & tectonics.

4.3 Weathering & cycle of erosion, upliftment, mass movement.

4.4 Fluvial Geomorphology, drainage pattern, fluvial land forms, Karst topography.

UNIT-V

5.1 Glacial features, type of glacier & Land forms.

5.2 Major landforms of arid region, effect of wind erosion.

5.3 Morphometric analysis of drainage basins & its significance.

5.4 Applied Geomorphology- Application of mineral prospecting, Civil engineering, Hydrology &environmental studies.

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M.Sc.GEOLOGY

SEMESTER-II

PAPER-IV

PHOTOGEOLOGY, REMOTE SENSING AND GIS

UNIT-I

1.1 Introduction to Photogeology and Remote Sensing, Type s of Aerial photographs.

1.2 Vertical, Low-oblique, High-oblique with their geometry. Nadir Point, Photogrammetry.

1.3 Photo-Scale variation and its causes. Flight Procedure, Tip and Tilt, Mosaic.

1.4 Stereoscopic vision, Stereoscope types, Pocket and Mirror stereoscope and their uses, Parallax, Vertical Exaggeration.

UNIT-II

2.1 Satellite Remote sensing, Types of sensors, Electromagnetic radiation (EMR) Interaction of EMR with earth objects.

2.2 Types of Images, MSS, Thermal Image, Qualitative interpretation of thermal image.

2.3 Multispectral Thermal data, Radar Image, Interaction between Radar and surface material.

2.4 Geological features on Radar Images.

UNIT-III

3.1 Interpretation of Aerial photographs, Tone, Texture and patterns, Landforms and Drainage, 3.2 Glacial landforms, Recognition of Rock Types Igneous, Extrusive and Intrusive rocks.

3.2 Sedimentary rock- coarse clastic sediments, fine clastic sediments and chemicallyprecipitated sedimentary rocks.

3.3 Metamorphic rocks in Stereo pair, Structural and stratigraphic relationships, Dip and strike,Unconformity, Structural relations.

UNIT-IV

4.1 Introduction to Digital Image Processing, Image Histogram, Contrast stretching, spatial frequency filtering.

4.2 Principal component Analysis, Band Rationing, Pattern recognition, Change detection.

4.3 Global Positioning system, GIS, its principle, Significance of GIS in Geology. Handling digital Geographical Information System data.

4.4 Analysis and use of multiple data planes, and Topographic Data in raster format. Synergistic interpretation of Geographic Information System.

UNIT-V

5.1 Application and significance of Remote Sensing studies in identification of lineaments folds, faults.

5.2 Groundwater targeting, Drainage pattern and its relation to rock types and structural features.

5.3 Use of remote sensing data in Mineral Exploration, Groundwater targeting, Petroleumexploration.

5.4 Use of remote sensing data in Engineering geology and environmental geology, Urban Land use.

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Books Recommended:

1. Remote Sensing : Principles and Application-	B.C. Panda
2. Remote Sensing and GIS	Bhatia B
3. Remote and GIS	M. Anjali Reddy.
4. Remote Sensing & Image Interpretation	Lilesand and Kiefer.
5. Fundamentals of Remote Sensing	George Joseph.
6. Remote Sensing and Geology	S. M. Ramasamy.
7. Image Interpretation in Geology	S. Drury.
8. Remote Sensing Principles and Interpretation	Sabins
9. Remote Sensing	Pandey,S.N
10. Photogeology	Miller & Miller

Lab Course-II
(M.Sc. Semester II)

Lab course II will consist of submission of a project report on the topic allotted to student by the supervisor.

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M.Sc.GEOLOGY

SEMESTER-III
PAPER-I

HYDROGEOLOGY

UNIT –I

1.1 Introduction to hydrogeology and its relation with hydrology, meteorology, water balance, significance of hydrometeriological data in ground water geology.

1.2 Hydrologic cycle, occurrence and distribution of sub surface water.

1.3 Water bearing formation- aquifers, aquitard, aquiclude & aquifer. Aquifer types-perched, unconfined, semi confined & confined. Isotropic, Anisotropic aquifer.

1.4 Hydrological properties of water bearing formations, porosity, types of opening in rocks(Primary &secondary)Darcy's law and its application, specific yield and specific retention, storativity and transmissivity and hydraulic conductivity.

UNIT-II

2.1 Water table, definition and location of water table free unconfined water, water table in porous, fractured and cavernous media, perched water table, lowering of water table due to pumping, area of influence upon pumping and drawdown and pressure surface.

2.2 Water table maps, construction and interpretations of fluctuations of water table andinfluencing factors.

2.3 Ground water mounds, trenches, divide, cascades, influent and effluent seepage artesianwells.

2.4 Ground water flow & permeability, steady & unsteady flow, G.W. flows near aquifer boundaries. Leaky aquifer.

Unit-III

3.1 Ground water wells, types of wells and methods of their construction-dug wells, driven wells and drilledWells, Inverted wells, recharge wells, tube wells, dug cum tube wells, function of well screen, gravel treatment.

3.2 Well development and completion, principle and various methods of developing wells, testing of wellsfor yield, specific capacity of wells.

3.3 Course of well failures, maintenance and well repair.

3.4 Methods of pumping test for aquifer analysis of test data.

Unit-IV

4.1 Geomorphic and geologic control of ground water, surface method (geological, hydrological and geophysical) of Exploration. Electrical resistivity method.

4.2 Sub surface methods of exploration- bore hole logging, geological, geophysical and other logging.

4.3 Application of remote sensing in ground water exploration, use of radioisotopes in hydrogeological studies.

4.4 Ground water provinces of India, Basin wise development of ground water with special reference toChhattisgarh region.

Unit-V

5.1 Quality of ground water- Chemical and Physical Characteristics of ground water for domestic, agricultural& industrial use.

5.2 Quality criteria for ground water use.

5.3 Ground water pollution, ground water recharge- natural and artificial.

5.4 Ground water development & management, conjunctive use of surface & ground water resources. Waterlogging, safe yield, overdraft and spacing of wells.

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External Subject Experts-

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Departmental members -

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M.Sc.GEOLOGY

SEMESTER-III

PAPER-II

ENGINEERING GEOLOGY & GEOTECHNICAL INVESTIGATIONS

UNIT-I

1.1 Importance of Engineering Geology in Civil Engineering.

1.2 Work activities of engineering geologist.

1.3 Guidelines for writing an engineering Geology report.

1.4 Engineering properties of rock material : specific gravity, density,porosity ,permeability, absorption , compressive strength, tensile strength ,shear strength, deformation moduli-Poisson's ratio.

UNIT-II

2.1 Engineering behavior of rock mass, description of rock mass. Rock mass classification of Terzaghi andNGI, RQD.

2.2 Metal & concrete aggregate, desirable properties for aggregate.

2.3 Important properties and test for rocks used as foundation sites, test and important properties desirable for building stone.

2.4 Grouting: Ground improvement techniques for rocks, Geotechnical consideration, and different types of grouting. Grouting for various engineering structures, efficacy of grouting .Rock bolting and anchoring, dental filling.

UNIT-III

3.1 Dam: Terminology & appurtenance, types of dam, types of spill ways with their parts.

3.2 Forces acting on dam, foundation and abutment problem, dam failure.

3.3 Geotechnical consideration for selection of dam sites.

3.4 Reservoirs: consideration for successful reservoirs, erosion of catchments area and siltation, reservoir capacity & life, environmental impact of creation of a reservoir.

UNIT-IV

4.1 Tunnels: components and types of tunnels, different stages of geotechnical investigation for tunnel.

4.2 Tunneling through rocks and soft ground: geological consideration.

4.3 Geological hazards in tunneling, effect of tunneling on the ground.

4.4 Methods of tunneling and support system.

UNIT-V

5.1 Bridge: Major types and acting force, supports and foundations of bridges.

5.2 Geological investigation of a bridge site, some case studies on bridges including Collapse Bridge.

5.3 Earthquakes magnitude & scale, Seismic zoning map of India and code for earthquake resistance.Seismotectonic frame work of India, geological consideration in seismic design.

5.4 Landslides:Types, description, causes, landslide hazard zonation mapping, landslide hazard mitigation& Prevention.

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Lab Course-I
(Paper I and II M.Sc. Semester III)

(A)

- Water table contour maps: study and construction, analysis of hydrographs and estimation of infiltration capacity.
- Chemical analysis of water in practical and study.
- Pumping test, time-draw down test and evolution of aquifer parameters.
- Study of electrical resistivity sampling data.
- Exercise on ground water exploration.

(B)

- Study of engineering properties of rocks.
- Study of maps and models of important engineering structures on dam sites tunnels etc.
- Study of the important ongoing engineering projects (Dams, Tunnels, building constructions, town planning (special reference to Naya Raipur and river front projects).

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M.Sc.GEOLOGY

SEMESTER-III

PAPER-III

MINING GEOLOGY & ENVIRONMENTAL GEOLOGY

UNIT-I

1.1 Introduction to mining terminologies like open cast mining, underground mining, pit, audit, tunnel, stoss, raise, etc.

1.2 Mining methods: Surface mining- alluvial, mineral sand, open pit, quarrying and open cast mining.

1.3 Mining methods: Sub surface mining- classification of stopping, underground development, different types of stopping.

1.4 Mining equipments: Drilling, shovel, dumpers, excavators etc.

UNIT-II

2.1 Mine supports, Ventilation, Drainage, Roofing.

2.2 Methods of breaking of rocks.

2.3 Role of geologist before the commencement of mining andduring the mining activity.

2.4 Choice of mining methods depending upon
(a) Geological structures (b) Deposits

UNIT-III

3.1 Mine valuation methods, Use of computers in mining.

3.2 Coal mining methods.

3.3 Study of important mining methods and operations at Malanjkhand Copper mine, Ironore mining at Bailadila and Kirandul.

3.4 Tin ore mining in Bastar, Limestone mining in Chhattisgarh.

UNIT-IV

4.1 Concept of environmental geology.

4.2 Necessity and application of studying environmental geology.

4.3 Role of geologist in environmental studies in mining activities, preventive and curative measures.

4.4 Deforestation, land degradation and calamities, afforestation, pollution due to mining and other geological activities.

UNIT-V

5.1 Impact assessment of anthropogenic activities such as urbanization, open cast miningand quarrying, river valley projects, disposal of industrial and radioactive waste.

5.2 Concept of EIA and EMP.

5.3 Preliminary rules for environmental clearance.

5.4 Environmental Impact of mining and role of geologist in preventive and curativemeasures.

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M.Sc.GEOLOGY

SEMESTER-III

PAPER-IV

MINERAL EXPLORATION

UNIT-I

1.1 Meaning and scope of prospecting and exploration.

1.2 Planning a prospecting program.

1.3 Different stages of prospecting activities.

1.4 Methods of prospecting: surface and sub surface.

UNIT-II

2.1 Optinga proper prospecting method depending upon the type of ore search.

2.2 Enlisting general prospecting methods depending upon type of ore search.

2.3 Concept of geochemical, geophysical, geological, stratigraphic, lithological prospecting methods.

2.4 Geophysical methods of prospecting ; their principles, applications and limitation in general.

UNIT-III

3.1 Gravity, magnetic, seismic and electrical methods of geophysical prospecting.

3.2 Sub surface methods of prospecting.

3.3 Subsurface geophysical methods of prospecting, different types of logging etc.

3.4 Prospecting plans and use of computers and modern computer based software in prospecting.

UNIT-IV

4.1 Sampling: Methods of sampling, choice of sampling method depending upon type ofore, precaution during the sampling and reduction of bulk samples.

4.2 Ore reserve estimation: Principle of ore reserve estimation in general, choosing theore reserve estimation method depending upon type of ore.

4.3 Calculation & interpretation of assay, average assay, grade, tonnage factor and reservecalculations there from.

4.4 Use of computers and computer based software's in reserve estimation.

UNIT-V

5.1 Drilling in exploration activities.

5.2 Types of drilling, various components.

5.3 Coring and lithological logging.

5.4 Holistic approach for prospecting (conjunctive approach of aerial survey, satelliteImageries, geochemical analysis, lithological studies, geophysical surveys).

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Lab Course-II
(Paper III and IV M.Sc. Semester III)

(A)

- Calculation of ore reserves an assay values.
- Diagrammatic representation of opencast and underground mining.
- Study of approved or otherwise mine planning.

(B)

- Viva voce on exploration plans for different types of ores.
- Exercise on various types of exploration strategies like geochemical and geophysical.
- Exercise on exploratory drilling and techniques of borehole logging.
- Exercise on geological mapping.

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M.Sc.GEOLOGY

SEMESTER-IV
PAPER-I

ECOMOMIC GEOLOGY – I (ORE FORMING PROCESSES)

UNIT – I

1.1 Modern concepts of ore genesis.

1.2 Classification of ore forming processes in general, genetically associated with igneous,sedimentary and metamorphic activities.

1.3 Ore bearing fluids, their origin and migration.

1.4 Textures, paragenesis and zoning in ores.

UNIT-II

2.1 Ore localization: structural, physico-chemical and stratigraphic controls of ore localization.

2.2 Wall rock alteration and Skarn deposits.

2.3 Sedimentary processes: precipitation, residual and mechanical concentration, placer, evaporates.

2.4 Oxidation and supergene enrichment processes.

UNIT – III

3.1 Magmatic deposits: Early and late magmatic processes, assimilation, filter pressing, gravity accumulation, dissemination.

3.2 Pegmatites and migmatitic processes of pneumatolitic deposits.

3.3 Hydrothermal processes of ore formation.

3.4 Introductory study and applications of fluid inclusion studies.

UNIT – IV

4.1 Metamorphic and metasomatic processes of ore deposition.

4.2 Study of geothermobarometry.

4.3 Stratiform and stratabound deposits.

UNIT – V

5.1 Plate tectonics and mineral deposition- global and Indian perspective.

5.2 Basic concepts of origin of coal.

5.3 Origin of petroleum.

5.4 Metallogenetic epoch and provinces in global as well as Indian context.

Note : there will be three section in each paper and each section will cover all the units. Section -A with 10 multiple choice/objective question of 1 mark each without internal choice. Section-B with five short answer type question of 4 marks each with internal choice and Section-C with five long answer type question of 10 marks each with internal choice.

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M.Sc.GEOLOGY

SEMESTER-IV

PAPER-II

ECONOMIC GEOLOGY – II
(INDIAN MINERAL DEPOSITS: METALLIC, NON-METALLIC AND FOSSIL FUEL)

UNIT – I

Mineralogical characteristics, geological setting, genesis (in short), distribution and uses of following ore deposits in India:

1.1 Iron and Manganese

1.2 Lead and Zinc

1.3 Chromium and Nickel

1.4 Alluminium

UNIT – II

Mineralogical characteristics, geological setting, genesis (in short), distribution and uses of following ore deposits in India:

2.1 Platinum and Cobalt

2.2 Gold and Silver

2.3 Tin, Tungsten and Molybdenum

2.4 Copper

UNIT – III

Characteristics, geological setting, genesis (in short), distribution and application of following non-metallic deposits of India:

3.1 Limestone and Dolomite

3.2 Gypsum and various Clays

3.3 Phosphorite and Feldspars

3.4 Sillimanite, kyanite, Andalusite

UNIT – IV

Characteristics, geological setting, genesis (in short), distribution and application of following non-metallic deposits of india:

4.1 Baryte (heavy spar), Micas

4.2 Asbestos, Graphite, Talc

4.3 Diamond, Garnet, Corundum

4.4 Gem mineral deposits

UNIT – V

5.1 Petroleum system: Concepts and definitions

5.2 Migration and accumulation of Petroleum. Structural, stratigraphic and Mixed Traps.

5.3 Petroleum deposits of India

5.4 Characteristics, grades, origin, geological setting, distribution and uses of Indian coal deposits with special reference to Chhattisgarh.

5.5 Study of coal and petroleum economics in global perspective.

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Lab Course-I

- Megascopic study of ore minerals in hand specimens.
- Identification of ore minerals in polished sections.
- Study of ore textures and structures.
- Practical related to application of ores in various industries.
- Plotting of famous ore deposits of world as well India on the maps.
- Mineral map of chhattisgarh (metallic and non mettalic)
- Mineral based industry of Chhattisgarh(location map)
- Coal deposit & gem minerals of Chhattisgarh
- List of major and minor minerals of Chhattisgarh
- Royalty rate of minor minerals of Chhattisgarh
- Make a chart of minerals used in :1 Cement industry 2 ferroallowa industry 3 alluminium based industry 4 ceremic and fertilizer industry 5 paints and pigments 6 refractory 7 building and decorative stone 8 road metal

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M.Sc.GEOLOGY

SEMESTER-IV

PAPER-III

CHHATTISGARH: GEOLOGY, MINERAL RESOURCES AND THEIR INDUSTRIAL APPLICATION

UNIT-I

1.1 General geological setup of Chhattisgarh state.

1.2 Study and preparation of Geological map of Chhattisgarh.

1.3 Geological formation with the short outline of their paleogeogarphy, palaeohistory and palaeoclimate.

1.4 Geological set up of Chhattisgarh state and its correlation with other equivalent formation of Indian subcontinent.

UNIT-II

2.1 Metallic deposits and mineral resources of Chhattisgarh state as data available with state and central govt. agencies.

2.2 Genetic Correlation of these (2.1) deposits and mineral resources with Geology of Chhattisgarh.

2.3 Metallic mineral deposits of Chhattisgarh like Bauxite, Iron Ore, Tin ore, gold and other reported resources.

2.4 Study of Grade and Quality of above given metallic mineral deposits and reported resources.

UNIT-III

3.1 Non metallic deposits and reported mineral resources of Chhattisgarh state as per data available with state and central govt. agencies.

3.2 Genetic correlation of these (3.1) deposits and mineral resources with the geology of Chhattisgarh.

3.3 Non-metallic deposits of Chhattisgarh like Coal, Limestone, Gypsum, Fluorite, Clay, Flagstone Silica and gem minerals like Corundum and Garnet.

3.4 Study of Grade and quality of above given non-metallic mineral deposits and reported resources.

UNIT-IV

4.1 An overview of minerals based industries of Chhattisgarh.

4.2 Minerals used in Iron & Steel industry with their specification.

4.3 Mineral used in Cement industries with their specification.

4.4 Mineral with their specification used in ferro-alloy and aluminium based industries.

UNIT-V

5.1 Other possible mineral based industries on the basis of study in unit 2.4

5.2 Other possible mineral based industries on the basis of study in Unit 3.4

5.3 Study of ongoing mineral based industries in other part of the country and abroad with similar mineral resources of Chhattisgarh.

5.4 Possible use of mineral resources of Chhattisgarh in ceramic, fertilizer, Paint and pigment, abrasive, building and decorative stone, pavement and road metal, refractory, chemical industries.

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M.Sc.GEOLOGY

SEMESTER-IV
PAPER-IV

MINING LAGISLATION AND MINERAL RESOURCES DEVELOPMENT

UNIT-I

1.1 Concept of act, rules & restriction of rules.

1.2 General concepts of RP (Reconnaissance Permit), PL (Prospecting License) and ML (Mining Lease)

1.3 MMDR-Mines & Minerals (Development &Regulation) act-1957 and amendments therein.

1.4 General restriction on undertaking prospecting and mining operations.

UNIT-II

2.1 Definition and scope of " mineral development" as per act

2.2 Procedure of obtaining prospecting license or mining lease in which the mineral vest in the government and other than government.

2.3 Section 5 to 13 of the above act for central government jurisdiction for mineral concession, power of state government under section 15 of the act for minor minerals, minor minerals as per list of government of Chhattisgarh.

2.4 Understanding of royalty, dead rent and others fees.

UNIT-III

3.1 Salient features of Mineral concession & Development Rule 1988 and amendments therein.

3.2 Understanding of reconnaissance, prospecting and mining operations in context of a geologist in them.

3.3 Salient features of mineral concession rule- 1960 and amendments therein.

3.4 Chhattisgarh minor mineral Rules, 2015.

UNIT-IV

4.1 Mining Plan, understanding the components of mining plans, understanding about its approval by appropriate authorities.

4.2 Progressive and final mine closure plans.

4.3 Mine planning for major and minor minerals, studies on geologists aspects therein.

4.4 Study of measures indicated in MCDR about protection of environment.

UNIT-V

5.1 Guidelines under MCDR for united nation framework classification (UNFC classification) of mineral resource/reserve.

5.2 Understanding of economic axis, feasibility axis and geological axis of classification.

5.3 Detailed account of mining plan in context of different ore reserves & geological conditions.

5.4 Study of any of the approved mining plan.

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Lab Course-II
(M.Sc. Semester IV)

In lab course II of semester IV each student has to undergo a practical training or choose a dissertation and submit a report. Topic for the dissertation would be allotted to the student by the supervisor.

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PSO AND CO OF M.Sc. GEOLOGY

M.Sc. 1st Semester, Paper-I : Mineralogy Mineral Optics and Crystallography

Program Specific Outcomes (PSOs)

PSO 1 The course deals with the study of minerals, their physical, chemical and optical properties.

PSO 2 The students will be able to identify rock forming minerals in hand specimens and in this section.

PSO 3 The course also includes study of various mineral groups and silicate structures.

PSO 4 The students learn the use of optical accessory, uniaxial and biaxial indicatrix and interference figure.

PSO 5 The student will be able to identify crystal morphology, symmetry, forms, classification and notation.

Course Outcomes (COs)

CO 1 Give a classification of minerals. Describe physical properties of minerals.

CO 2	Explain polymorphism, pseudo morphism, isomorphism in minerals.
CO 3	Various group of minerals.
CO 4	Discuss various properties of mineral under microscope.
CO 5	Describe holohedral, hemihedral, hemimorphy forms of crystals, crystallographic notation.
CO 6	Describe symmetry characters and forms of normal class of different crystal systems.

M.Sc. 1st Semester : Paper-II : Structural Geology

Program Specific Outcomes (PSOs)

PSO 1	This course deals with the understanding of the structures, their form and origin that are found in the crustal rocks.
PSO 2	The students will be able to know about concepts of stress and strain analysis to understand deformations.
PSO 3	To understand types, classification, geometric characterization of structures as fold, fault, joint, lineation etc.
PSO 4	The course also deals with the understanding of structures in term of mechanism of deformation.
PSO 5	To render use of various tools and techniques of field mapping.

Course Outcomes (COs)

CO 1	How to use stress strain analysis to explain rock deformation.
CO 2	Explain the elements of folds? Describe classification and mechanics of folding.
CO 3	Elements of fault, Geometric and genetic classification.

CO 4 Discuss the recognition of told, fault and unconformities in field and geological maps.

CO 5 What are the linear planar fabrics in rocks and establish their relation to major structures.

M.Sc. 1st Semester Paper-III : Principles of stratigraphy and Indian Geology

Program Specific Outcomes (PSOs)

PSO 1 This paper design to understand the aspects of the age of the earth, chronological arrangement of rocks and appearance and evolution of life through the geologic time.

PSO 2 The knowledge of the concepts in stratigraphy, correlation would enable the students to understand the changes that occurred in the history of the earth and relate them to their field observation and also in understanding the frame work of the stratigraphy of India.

Course Outcomes (COs)

CO 1 Give an account of criteria of stratigraphic correlation discuss importance of paleoclimate and paleogeography in stratigraphy.

CO 2 Describe stratigraphic column, distribution in India, fossil content and economic importance of a geological formation.

M.Sc. 1st Semester : Paper-IV : Paleontology

Program Specific Outcomes (PSOs)

PSO 1 Understanding the process of preservation of fossils.

PSO 2	Students will be able to recognize the major groups of invertebrate fossils on the basis of their morphological characters and be able to identify index fossils.
PSO 3	Students will learn the use of fossils to recognize the age of sedimentary strata, in solving geological problems, paleo-environments, relative age, paleo-ecology etc.

Course Outcomes (COs)

CO 1	Describe preservation of fossils.
CO 2	Define and describe fossils, index fossils.
CO 3	Application of fossils in establishing age of the rock unit and correlation with other area.