

PATNA UNIVERSITY

DEPARTMENT OF GEOLOGY

M.Sc. (GEOLOGY) SEMESTER SYSTEM W.E.F 2015-17

Candidates who have passed the three year B.Sc. (Hons.) examination of Patna University or any other equivalent examination of other universities with Honours in Geology will be considered eligible for admission to the Four Semester M.Sc. course in Geology.

The M.Sc. course in Geology shall be imparted to the students for two academic sessions consisting of four semesters (a total of 1600 marks) as given below. Candidates will be examined and evaluated at the end of each semester (400 marks) in the different courses of theory and practical as per continuous internal assessment (CIA) and semester examinations (conducted by the University). The M.Sc. Geology will consist of (a) Core Courses (b) Elective Courses.

- (a) The Core courses will be compulsory for all the students admitted to M.Sc. Geology. There will be core courses of 100 marks each ((theory - 10 papers, and practical- 3 papers) and two sessions of two to three weeks of geological field training. After the field training, the students will be required to submit a detailed field report to the concerned teacher for evaluation. The attendance in the geological field training will be compulsory for all the students.
- (b) The students admitted will have to study one **elective** paper of 300 marks (Theory- 200 and Practical-100) during the IIIrd and IVth Semester.
- (c) There shall be a Project Oriented Dissertation, carrying 100 Marks, assigned to the students at the start of IIIrd Semester. This Dissertation must be submitted before the end of the IVth Semester for evaluation by the Faculty members and the Board of Examiners.

Marks for theory and practical examination shall be as per the following :

Exam. Components	Marks for Semester Exam.	Intra-Sessional Semester Test + Class Assignment and Regularity (CIA)	Intra-Sessional semester practical Assessment + Class assignment and Regularity (CIA)	Total Marks
Theory	70	30 (15 +5+5+5)	-	100
Practical	70	-	30 (15+5+5+5)	100

SEMESTER - I

Code	CORE COURSE	Credit	CIA	End Semester Exam (ESE)	Total
Geol-M-101	GEOMORPHOLOGY and REMOTE SENSING & GIS	4	30	70	100
Geol-M-102	GENERAL GEOLOGY, GEOTECTONICS & STRUCTURAL GEOLOGY	4	30	70	100
Geol-M-103	MINERALOGY, CRYSTALLOGRAPHY, & OPTICAL MINERALOGY	4	30	70	100
Geol-M-104	PRACTICAL	6	30	70	100
Total		18	120	280	400

SEMESTER - II

Code	CORE COURSE	Credit	CIA	End Semester Exam (ESE)	Total
Geol-M- 201	IGNEOUS PETROLOGY & GEOCHEMISTRY	4	30	70	100
Geol-M- 202	SEDIMENTARY PETROLOGY & METAMORPHIC PETROLOGY	5	30	70	100
Geol-M- 203	HYDROGEOLOGY, ENGINEERING GEOLOGY & ENVIRONMENTAL GEOLOGY	5	30	70	100
Geol-M- 204	PRACTICAL	6	30	70	100
Total		20	120	280	400

SEMESTER - III

Code	CORE COURSE	Credit	CIA	End Semester Exam (ESE)	Total
Geol-M- 301	ECONOMIC GEOLOGY	4	30	70	100
Geol-M- 302	STRATIGRAPHY & PALAEOLOGY	4	30	70	100
Geol-M- 303	ELECTIVE PAPER	6	30	70	100
	ADVANCED HYDROGEOLOGY				
	FUEL GEOLOGY				
	SEDIMENTOLOGY				
Geol-M- 304	PRACTICAL (CORE COURSES)	6	30	70	100
Total		20	120	280	400

SEMESTER - IV

Code	CORE COURSE	Credit	CIA	End Semester Exam (ESE)	Total
Geol-M- 401	STARATIGRAPHY & PALAEOLOGY	4	30	70	100
Geol-M- 402	ELECTIVE PAPER	6	30	70	100
	ADVANCED HYDROGEOLOGY				
	FUEL GEOLOGY				
	SEDIMENTOLOGY				
Geol-M- 403	PRACTICAL (ELECTIVE PAPER)	6	30	70	100
Geol-M- 404	PROJECT ORIENTED DISSERTATION	6	30	70	100
Total		22	120	280	400

SEMESTER-I
PAPER : Geol-M-101
GEOMORPHOLOGY AND REMOTE SENSING & GIS

The pattern of question papers will be as under

Group A – Compulsory – ten questions (two from each unit) of 2 marks each,
2×10 = 20 marks

Group B –Five questions (one from each unit) of 5 marks each, four to be
answered, *5×4 = 20 marks*

Group C –Five questions (one from each unit) of 10 marks each, three to be
answered *10×3= 30 marks*

Full Marks : 70

Geomorphology

Unit-I

- Principles & dynamics of Geomorphology
- Geomorphic Mapping – elementary idea.
- Applications of geomorphology in
 - Engineering Studies,
 - Agriculture & Forestry,
 - Land use planning,
 - Mineral Prospecting,
 - Hydrology,
 - Environmental Studies.

Unit-II

Evolution of different geomorphological terrains of India-

- ❖ Peninsular India
- ❖ Extra-peninsular India
- ❖ Rajasthan deserts &
- ❖ Coastal plains;
- ❖ Indo-Gangetic plains with special reference to Bihar plains,

Unit-III

- Fluvial Landforms and drainage patterns.
- Characteristic landforms of
 - glacial,
 - karst,
 - aeolian &
 - marine environment.
- Geomorphic cycle

Aerial Photography, Remote Sensing and GIS**Unit-IV**

- Basic idea of Aerial Photograph & Photogrammetry
- Uses of Aerial photographs in
 - Terrain evaluation
 - Mineral exploration
 - Geological mapping & soil mapping
 - Evaluation of Ground water potential

Unit-V

- Principles of Remote Sensing
- Digital Image processing
- Polar orbiting Remote Sensing & Geostationary Environmental satellites.
- Global & Indian Space Programme.
- Application of Remote Sensing Techniques in-
 - Systematic mapping
 - Groundwater studies
 - Land use & Landform mapping
 - Environmental monitoring & mapping
 - Mineral resources
- Principles and components of GIS ; Applications of GIS in geology

SEMESTER-I
PAPER : Geol-M-102
GENERAL GEOLOGY , GEOTECTONICS & STRUCTURAL GEOLOGY

The pattern of question papers will be as under

Group A – Compulsory – ten questions (two from each unit) of 2 marks each,
 $2 \times 10 = 20$ marks

Group B –Five questions (one from each unit) of 5 marks each, four to be
 answered, $5 \times 4 = 20$ marks

Group C –Five questions (one from each unit) of 10 marks each, three to be
 answered $10 \times 3 = 30$ marks
Full Marks : 70

General Geology and Geo-tectonics:

Unit-I

- Radioactivity and Geochronology
- Internal structure and chemical composition of the Earth with special reference to seismic evidences and phase transitions.
- Seismology and seismic belts of India.

Unit-II

- Geosynclines and Mountain building.
- Palaeo-magnetism & its significance in Geology
- Sea-floor spreading and Plate Tectonics – a detailed study of different plate boundaries, relation with continental drift & mountain building
- Rift valley & Island Arcs

Unit-III

- Isostasy and its applications
- Evolution of continent and Ocean
- Structure and origin of the Alpine – Himalayan Belt
- Tectonic evolution of the Indo – Gangetic Plains
- Tectonics of Precambrian Orogenic Belts of India.

Structural Geology:**Unit-IV**

- Mechanical principles, properties & their controlling factors.
- Theory of rock failure.
- Concept of stress & strain, types of strain ellipses & ellipsoids – their properties & geological significance.
- Planar & linear fabrics in deformed rocks, their origin & significance.
- Basic idea about petro-fabrics.

Unit-V

- Mechanics of folding & buckling, outcrops of folded strata, economic significance of folds.
- Causes & dynamics of faulting: Strike – slip fault, Normal fault, Thrust fault, economic significance of faults
- Effects of faulting on the outcrops & folded strata.

SEMESTER-I
PAPER : Geol-M-103
MINERALOGY, CRYSTALLOGRAPHY, & OPTICAL MINERALOGY

The pattern of question papers will be as under

Group A – Compulsory – ten questions (two from each unit) of 2 marks each,
 $2 \times 10 = 20$ marks

Group B –Five questions (one from each unit) of 5 marks each, four to be answered,
 $5 \times 4 = 20$ marks

Group C –Five questions (one from each unit) of 10 marks each, three to be answered
 $10 \times 3 = 30$ marks

Full Marks : 70

Mineralogy

Unit-I

- Structural classification of silicates.
- Crystal chemistry- isomorphism, polymorphism with special reference to K-feldspar, solid solution and unit cell.
- Mineral systematics -Crystal structure, diagnostic properties, P-T stability – Phase diagram.

Unit-II

- Crystal Structure, diagnostic properties, paragenesis and alteration of Feldspar, Mica, Silica, Olivine, Pyroxene and Amphibole groups.

Unit-III

- Crystal structure, diagnostic properties, paragenesis, alteration of rock groups- Alumino – silicates, Felspathoids, Epidote, Garnet and Chlorite.
- Brief study of the following minerals-
Talc, gypsum, calcite, fluorite, apatite, topaz, corundum, magnetite, pyrite, spinel, andalucite, kyanite, galena, tourmaline, beryl, barite, chlorite, sphene, vesuvianite.

Crystallography :

Unit-IV

- Formation and growth of crystals.
- Space lattices and space groups
- Derivation of 32 classes of symmetry.
- Detailed study of the six crystal systems viz., Isometric, Tetragonal, Hexagonal, Orthorhombic, Monoclinic, Triclinic.
- Twinning and laws of twinning.
- X-ray studies of crystals by common methods.

Optical Mineralogy:

Unit-V

- Isotropic and anisotropic minerals.
- Refractive index and its determination.
- Birefringence and its determination.
- Uniaxial and Biaxial indicatrix.
- Behaviour of convergent polarized light in uniaxial and biaxial minerals.
- Optic sign determination.
- Construction and uses of Quartz wedge, Mica Plate and Gypsum plate.
- Berek Compensator and Dispersion.

PAPER : Geol-M-104 (Practical)

- Interpretation of Aerial Photograph & satellite imageries
- Geological maps and sections and problems related with them.
- Structural problems related with true and apparent dips, thickness and three-point problem.
- Stereographic projection and their use in structural analysis
- Clinographic Projections of Trapezohedron, Pyritohedron, Zircon, Vesuvianite, Cassiterite, Barite, Olivine, Gypsum.
- Stereographic projection and determination of Axial ratio of Crystal models
- Determination of R.I., Scheme of Pleochroism, An-Content,
- Optic sign determination
- Viva-Voce & Records

BOOKS RECOMMENDED

Geomorphology:

- Thornbury, W.D. 1980: **Principles of Geomorphology**. Wiley Easton Ltd., NY
- Holmes, A. 1992: Holmes **Principles of Physical Geology** Edited by P. McL. D. Duff. Chapman and Hall, London.
- Halis, J.R. 1983:; **Applied Geomorphology**
- Sharma, H.S. 1990: **Indian Geomorphology**. Concept Publishing Co New Delhi
- Singh, S., **Geomorphology**
- Kale & Gupta , **Introduction of geomorphology**
- Sen and Prasad, **Geomorphology of India**
- Mahadevan, T. M. , **Geology of Bihar & Jharkhand**

Photogeology & Remote Sensing

- Pandey, Shiv N., **Principles and Applications of Photogeology** ,Wiley Eastern.
- Joseph, George. **Fundamentals of Remote Sensing** ,University Press (India)
- Jensen, John R., **Remote Sensing of the Environment** , Prentice Hall
- Cracknell, A. P. & Hayes, L. B. W., **Introduction of Remote sensing** , Jaylor & Francis.
- Lille Sand & Koefes, **Remote Sensing & Image Interpretation** –John Wiley
- Curran, Paul J., **Principles of Remote Sensing**, ELBs
- Drury, S. A., **Image interpretation in Geology** , Allen & Unwin.
- Bruns & Francs , **Photogeology** , Oxford & IBH.

Geotectonics & Structural Geology

- Condie. Kent. C., **Plate Tectonics and Crustal Evolution**, Pergamon Press
- Gass I.G. , **Understanding the Earth**. Artemis Press (Pvt) Ltd. U.K.
- Ghos. S.K., **Structural Geology : Fundamental and Modern Development**. Pergamon Press.
- Hobbs. B.F, Means. W.D. and Williams. P.F., **An outline of Structural Geology**. John Wiley and Sons. New York
- Naqvi. S.M. ,**Geology and Evolution of the Indian Plate (From Hadean to Holocene – 4Ga to 4Ka)**, GSI. Bangalore
- Ramsay. J. G. , **Folding and fracturing of rocks**, McGraw Hill.
- Windley B., **The Evolving continents**. John Wiley and Sons, New York.
- N. J. Price and J. W. Cosgrove , **Analysis of Geological Structures**. CUP
- Turner. F.J. and Weiss, L.E. (1963): **Structural analysis of Metamorphic Tectonites** , McGraw Hill.
- Ramsay, J.G. and Huber, M.I., **Techniques of Modern Structural Geology. Vol. I. Strain Analysis**. Academic Press.
- Ramsay, J.G. and Huber, M.I., **Techniques of Modern Structural Geology. Vol. II. Folds and Fractures**. Academic Press.

Crystallography & Mineralogy

Flint, **Crystallography**

Tutton, **Crystallography**

Dana, E.S. and Ford, W.E.: **A textobok of Mineralogy**

Deer, W.A., Howie, R.A. & Zussman, J. : **An Introduction to the rock forming minerals**, ELBS and Longman

Berry, L.G., Mason, B. and Dietrich, R.V.: **Mineralogy**, CBS Publishers

Philips, F.C. **Introduction to Crystallography**

Kerr, P.F.: **Optical Mineralogy**

Moorhouse, W.W.: **Optical Mineralogy**

Winchell, E.N.: **Elements of Optical Mineralogy**

Nesse, D.W.: **Optical Mineralogy**, McGraw Hill.

Ramsay, J.G. and Huber, M.I., **Techniques of Modern Structural Geology. Vol. I. Strain Analysis.** Academic Press.

Ramsay, J.G. and Huber, M.I., **Techniques of Modern Structural Geology. Vol. II. Folds and Fractures.** Academic Press.

SEMESTER – II
PAPER : Geol-M- 201
IGNEOUS PETROLOGY & GEOCHEMISTRY

The pattern of question papers will be as under

Group A – Compulsory – ten questions (two from each unit) of 2 marks each,
2×10 = 20 marks

Group B –Five questions (one from each unit) of 5 marks each, four to be
answered, **5×4 = 20 marks**

Group C –Five questions (one from each unit) of 10 marks each, three to be
answered **10×3= 30 marks**

Full Marks : 70

Igneous Petrology

Unit-I

- Magma – nature, types, composition, generation and emplacement with special reference to tectonic environment of evolution
- Crystallisation of magma – Bowen's Reaction series ; Fractional crystallisation
- Classification of Igneous rocks
- Diversity in Igneous rocks
- *Major Igneous Activities in India* – Dalma Volcanics, Malani Rhyolites, Deccan & Rajmahal volcanics

Unit-II

- Basalts – its types & tectonic environments,
- Application of trace elements including REE and Sr – isotopic studies in Igneous petrology
- Petrogenesis of Granites & Pegmatites

Unit-III

- Phase rule and interpretation of Binary Systems with complete solid solution and also with liquid immiscibility.
- Ternary Systems
 - with congruently melting binary phases.
 - With incongruently melting binary phases.
 - With liquid immiscibility.

Unit-IV

- *General features and Petrogenetic aspects of important rock suites of India, viz.:*
 - Layered Igneous Complexes, Ultramafic Rocks, Ophiolites, Anorthosites, Alkaline Rocks, Kimberlites, Carbonatites.

Geochemistry**Unit-V**

- Geochemical differentiation of the Earth
- Distribution of Elements
- Geochemical classification of elements
- Structure & composition of the earth
- Geochemistry of Lithosphere, Atmosphere, Hydrosphere & Biosphere
- Elementary principles of Thermodynamics
- Geochemical cycle

SEMESTER – II
PAPER : Geol-M-202
SEDIMENTARY PETROLOGY AND METAMORPHIC PETROLOGY

The pattern of question papers will be as under

Group A – Compulsory – ten questions (two from each unit) of 2 marks each,
 $2 \times 10 = 20$ marks

Group B –Five questions (one from each unit) of 5 marks each, four to be answered,
 $5 \times 4 = 20$ marks

Group C –Five questions (one from each unit) of 10 marks each, three to be answered
 $10 \times 3 = 30$ marks
Full Marks : 70

Sedimentary Petrology:

Unit-I

- Sedimentary Processes – weathering, sediment transport – fluid flow concept
- Texture of sedimentary works – grade scales, graphical representation, sphericity, roundness, porosity & permeability
- Sedimentary structures – their origin & significance
- Lithification and diagenesis -- principles

Unit-II

- Classification of sedimentary rocks
- Classification of Sandstones
- Limestone and Dolomites – classification, origin & diagenesis
- Provenance – Concept of textural and compositional maturity, light & heavy minerals, Heavy minerals as indicators of provenance

Unit-III

- Environment of sedimentation : Parameters, Classification, processes and characteristics
- Sedimentary facies : Orthoquartzite, Carbonate, Red Beds, Euxenic, Molasse, Flysch, Sabkha facies.

Metamorphic Petrology:**Unit-IV**

- Metamorphism - Texture & Structure
- Classification of Metamorphic Rocks
- Metamorphic Differentiation
- Anatexis and Migmatites
- Plate Tectonics and metamorphism
- Metamorphic Facies – Concept and classification; Facies Series

Unit-V

- Mineralogical Phase Rule
- Laws of Thermodynamics
- ACF, AFM Diagrams ; P-T Paths
- Nature of Metamorphic Reactions, Isograds & Reaction Isograds
- Regional metamorphism of Pelitic rocks & Calcareous rocks
- Contact metamorphism of Pelitic & Calcareous rocks

SEMESTER – II
PAPER : Geol-M-203
HYDROGEOLOGY, ENVIRONMENTAL GEOLOGY & ENGINEERING
GEOLOGY

The pattern of question papers will be as under

Group A – Compulsory – ten questions (two from each unit) of 2 marks each,
2×10 = 20 marks

Group B –Five questions (one from each unit) of 5 marks each, four to be
 answered, ***5×4 = 20 marks***

Group C –Five questions (one from each unit) of 10 marks each, three to be
 answered ***10×3= 30 marks***

Full Marks : 70

Hydrogeology:

Unit-I

- Hydrological cycle & the role of groundwater in the cycle.
- Aquifers and their types
- Springs
- Hydrological Properties of water-bearing formations- porosity, permeability, transmissibility, storage coefficient, specific yield, specific retention

Unit- II

- Groundwater exploration: geological and geophysical methods.
- Rain water harvesting & Artificial recharge.
- Groundwater provinces of India.
- Groundwater resources of Bihar.
- Groundwater quality: physical and chemical characteristics; arsenic and fluoride contamination.

Environmental Geology

Unit-III

- Concept of Environmental Geology
- Basics of natural Ecosystem on the Earth and their mutual interrelation & interaction with Atmosphere, Hydrosphere, Lithosphere & Biosphere.
- Natural Hazards – Floods, Landslides Coastal Hazard, Earthquake & their mitigation.

Unit- IV

- Environmental impact of urbanization, open cast mining and radioactive waste disposal.
- Soil profile & soil quality degradation due to irrigation, fertilizer and pesticides.
- Impact assessment of degradation & contamination of water quality due to industrialization & urbanization.
- A brief study of the following :
 - Disposal of solid waste
 - Thermal pollution & Noise-pollution
 - Pollution of rivers
 - Conservation of mineral resources.
 - Global warming and sea level changes

Engineering Geology:

Unit-V

- Engineering properties of rocks
- Geological & environmental considerations in the location and construction of Dams, Reservoirs, Tunnels and Highways
- Stability of Hill Slopes, Landslides

SEMESTER – II

PAPER : GEOL-M-204 (PRACTICAL)

- Megascopic and thin section study of igneous rocks.
- Megascopic and thin section study of sedimentary rocks
- Megascopic and thin section study of metamorphic rocks
- Surveying : Plan Table and Prismatic Compass
- Location of ground water provinces on outline map of India
- Chemical analysis of water and study of hydrological properties of water
- Viva-Voce & Sessional records.

Books Recommended:

- Bose, M.K., **Igneous Petrology**, World Press, Kolkata.
- Best, Myron G., **Igneous and Metamorphic Petrology**, Blackwell Science.
- Cox, K.G., Bell, J.D. and Pankhurst, R.J., **The Interpretation of Igneous Rocks**. Chapman & Hall, London.
- Faure, G. **Origin of Igneous Rocks**, Springer.
- Hall, A., 1997 **Igneous Petrology**, Longman.
- LeMaitre, R.W., **Igneous Rocks: A Classification and Glossary of Terms**, Cambridge University Press.
- McBirney, **Igneous Petrology**, CBS Publishers, Delhi.
- Phillipotts, A.R., **Principles of Igneous and Metamorphic Petrology**, Prentice Hall of India.
- Sood, M.K., **Modern Igneous Petrology**. Wiley-Interscience Publ., New York.
- Srivastava, Rajesh K. and Chandra, R., **Magmatism in Relation to Diverse Tectonic Settings**.
- Wilson, M., **Igneous Petrogenesis**. Chapman & Hall, London.
- Winter, J.D., **An Introduction to Igneous and Metamorphic Petrology**. Prentice Hall, New Jersey.
- Turner, F.J. and Weiss, L.E. (1963): **Structural analysis of Metamorphic Tectonites**, McGraw Hill.
- Winter, J.D. 2001 **An introduction to Igneous and Metamorphic Petrology**, Prentice Hall.
- Bucher, K. and Martin, F. 2002 **Petrogenesis of Metamorphic Rocks**, Springer – Verlag, 7th Edition.
- Yardley, B.W.D. 1989 **An introduction to Metamorphic Petrology**, Longman, New York.
- Rastogy, R.P. and Mishra, R.R. 1993: **An Introduction to Chemical Thermodynamics**, Vikash Publishing House.
- Yardley, B.W.D., Mackenzie, W.S. and Guilford, C. 1995 **Atlas of Metamorphic Rocks and their textures**, Longman Scientific & Technical, England.
- Spry, A. 1976 **Metamorphic Textures**, Pergamon Press.
- Blatt, H. and Tracy, R.J. 1996 **Petrology (Igneous, Sedimentary, Metamorphic)**, W.H. Freeman & Co.
- Blatt, H., Middleton, G.V. and Murray, R.C. (1980): **Origin of Sedimentary Rocks**, Prentice-Hall Inc.
- Collins, J.D., and Thompson, D.B. (1982): **Sedimentary Structures**. George Allen & Unwin, London.
- Lindholm, R.C. (1987) **A Practical Approach to Sedimentology**. Allen & unwin, London.
- Miall, A.D. (2000): **Principles of Basin Analysis**, Springer-Verlag.
- Pettijohn, F.J. (1975): **Sedimentary Rocks**. 3rd Edn. Harper and Row Publ., New Delhi.
- Reading, H.E. and Singh, I.B. (1973): **Depositional Sedimentary Environments**. Springer-Verlag.
- Selley, R.C. (2000) **Applied Sedimentology**, Academic Press.
- Tucker, M.E. (1981): **Sedimentary Petrology: An Introduction**, Wiley & Sons, New York.
- Tucker, M.E. (1990): **Carbonate Sedimentology**, Blackwell Scientific Publication.
- Todd, D.K. **Groundwater Hydrology**. John Wiley.
- Davies, S.N. and Dewiest, R.J.M. – **Hydrogeology**, John Wiley.
- Fetter, C.W. **Applied Hydrogeology**, Merrill Publishing.
- Raghunath, H.M. – **Ground water**. – Wiley Eastern.
- Karanth. K.R. – **Groundwater Assessment – Development and Management**. Tata Mc. Grew Hill.
- Krynine. D.H. and Judd, W.R. – **Principles of Engineering Geology**, CBS Edition.
- Valdiya, K.S., **Environmental Geology- Indian context**, Tata McGraw Hill
- Keller, E. A., **Environmental Geology**, Bell & Howell, USA
- Subramaniam, V., **Textbook in Environmental Science**, Narosa International
- Smith, K. , **Environmental Hazards**, Routledge, London

SEMESTER – III
PAPER: GEOL-M-301
ECONOMIC GEOLOGY

The pattern of question papers will be as under

Group A – Compulsory – ten questions (two from each unit) of 2 marks each,
 $2 \times 10 = 20$ marks

Group B –Five questions (one from each unit) of 5 marks each, four to be answered,
 $5 \times 4 = 20$ marks

Group C –Five questions (one from each unit) of 10 marks each, three to be answered
 $10 \times 3 = 30$ marks

Full Marks : 70

Unit-I

- Classification of mineral deposits
- Processes of formation of mineral deposits – Magmatic Concentration, Supergene Sulphide Enrichment, Hydrothermal, Residual & Placer etc.
- Methods of prospecting:
 - Geological,
 - Geophysical,
 - Geochemical

Unit- II

- Mineral Economics : concept & significance
- Mineral beneficiation & Ore-dressing
- Controls of Ore localization
- Mineral paragenesis & Zoning
- Metallogenetic epochs & provinces with special reference to India
- Plate Tectonics & Metallogeny
- Conservation of minerals : Strategic, Critical & Essential minerals.
- National Mineral Policy
- Law of the Sea beds for marine mineral resources.

Unit-III

- Study Of host rock- lithology, mineralogy, tectonic setting and distribution in time & space of :
 - Porphyry copper
 - Volcanogenic massive sulphide deposits
 - Sediment – hosted base metal deposits
 - BIF's
 - Skarn deposits

Unit-IV

- Occurrence, distribution, genesis & uses of metallic/non-metallic minerals of India: Iron, Copper, Lead-Zinc, Manganese, Chromite, Bauxite, Mica, Gold, Atomic minerals, Abrasives & Refractory minerals.

Unit-V

- Coal : Definition and Chemical aspects of coal (Proximate & ultimate analysis)
- Origin of coal
- Classification of coal
- Coal Petrography (in brief)
- Distribution of coal in India
- Coal Bed Methane – basic idea.
- Origin of Petroleum
- Migration & Accumulation of Oil
- Reservoir Rocks and Traps, Oil Shales
- Well Logging & oil exploration – in brief
- Petroliferous basins of India.

SEMESTER – III
PAPER : GEOL-M-302
STRATIGRAPHY AND PALAEOLOGY

The pattern of question papers will be as under

Group A – Compulsory – ten questions (two from each unit) of 2 marks each,
 $2 \times 10 = 20$ marks

Group B –Five questions (one from each unit) of 5 marks each, four to be answered,
 $5 \times 4 = 20$ marks

Group C –Five questions (one from each unit) of 10 marks each, three to be answered
 $10 \times 3 = 30$ marks

Full Marks : 70

Stratigraphy:

Unit-I

- Principles of stratigraphy and correlation
- Stratigraphic classification & Nomenclature viz. Litho-, Bio- and Chrono-stratigraphic units
- Facies Concept
- Brief study of seismic-, magneto- and sequence stratigraphy

Unit-II

- Archaean Stratigraphy :
 - Structure, tectonics & Stratigraphy of Singhbhum craton
 - Classification, Structure & tectonics of Dharwar craton
 - Bundelkhand Granite gneiss complex
 - Stratigraphy of central India – Sausar, Sakoli and Chilpi Groups.
- Archaean – Proterozoic Boundary

Unit-III

- Precambrian stratigraphy : Formation of early crust, greenstone – granulite belts, subdivisions of Precambrian

Proterozoic Stratigraphy :

- Stratigraphy, sedimentation, tectonics and evolution of Delhi-Aravalli supergroup, Kolhan Group
- Cuddapah – Kurnool Supergroup and equivalents
- Vindhyaans – sedimentation, life, stratigraphy and economic importance.
- Precambrian – Cambrian Boundary

Palaeontology:

Unit-IV

- Principles and divisions of Palaeontology
- Fossilisation – Preservation & Taphonomy
- Biostratigraphy – basic idea
- Origin of life ; Life through the Ages
- Mass Extinctions & their causes
- Palynomorphs & Ichnofossils (in brief)

Unit-V

- Organic Evolution -- theories and evidences
- Mechanism & Modes of Evolution
- Classification and account of vertebrate life during geological time
- Siwalik mammals & causes of their extinction
- Evolutionary trends in
 - Homosapiens,
 - Equidae, &
 - Proboscidae.

SEMESTER – III
PAPER: GEOL-M-303
ADV. HYDROGEOLOGY (ELECTIVE PAPER)

The pattern of question papers will be as under

Group A – Compulsory – ten questions (two from each unit) of 2 marks each,
 $2 \times 10 = 20$ marks

Group B –Five questions (one from each unit) of 5 marks each, four to be answered,
 $5 \times 4 = 20$ marks

Group C –Five questions (one from each unit) of 10 marks each, three to be answered
 $10 \times 3 = 30$ marks

Full Marks : 70

Unit I :

- Distribution of water on the Earth- World's total water supply,
- Origin of water : meteoric, juvenile, connate, magmatic and sea water;
- Hydrologic cycle : Precipitation, run-off, infiltration and evapo-transpiration; Groundwater in the hydrologic cycle;
- Age of Ground Water;
- Hydrographs; Water table contour maps;
- Subsurface movement and vertical distribution of groundwater;
- Water table fluctuations- causative factors; Concept of barometric and tidal efficiencies.

Unit II :

- Aquifers and their types;
- Springs; Thermal springs; Geothermal energy resources;
- Rock properties affecting groundwater : porosity, permeability, specific yield, specific retention, hydraulic conductivity, transmissivity, storage coefficient;
- Geologic formations as aquifers;
- Hydrostratigraphic units.

Unit III :

- Theory of groundwater flow;
- General flow equations, steady unidirectional flow, steady radial flow to a well, unsteady radial flow in confined and unconfined aquifers;
- Darcy's Law and its applications;
- Permeability and its determination in laboratory and in field;
- Hydraulic conductivity and its determination;
- Groundwater tracers.

Unit IV :

- Water well technology : Well types; drilling methods;
- Construction, design, development and maintenance of wells,
- Specific capacity and its determination;
- Pump test- methods, data analysis and interpretation for hydrologic boundaries;
- Groundwater modelling- numerical and electrical methods.

Unit V :

- Groundwater quality- physical and chemical characteristics of groundwater,
- Chemical analysis;
- Changes in chemical composition;
- Water quality criteria for domestic, irrigational and industrial uses;
- Graphical representation of water quality data;
- Radioisotopes in groundwater studies;

SEMESTER – III
PAPER: GEOL-M-303
FUEL GEOLOGY (Elective Paper)

The pattern of question papers will be as under

Group A – Compulsory – ten questions (two from each unit) of 2 marks each,
 $2 \times 10 = 20$ marks

Group B –Five questions (one from each unit) of 5 marks each, four to be
 answered, $5 \times 4 = 20$ marks

Group C –Five questions (one from each unit) of 10 marks each, three to be
 answered $10 \times 3 = 30$ marks

Full Marks : 70

Unit-I

- Fundamentals; sedimentology & structures in coal-bearing strata
- Chemical Aspects of coal ; Proximate & Ultimate Analysis
- Origin of Coal – Theories and evidences; Peatification
 -- changes undergone during Coalification

Unit-II

- Classification of coal
 - Indian & International classifications
 - Seyler's classification
- Coal Petrography – Lithotypes (Banded Constituents of coal)
- Macerals & micro-lithotypes;
- Vitrinite reflectance ; Applications of Coal Petrography

Unit-III

- Coal carbonization – Low & High temperature types;
 -- Methods, Bi-Products; Coal Coke
- Coal washing – types & methods
- Coal Mining – opencast & underground methods

Unit-IV

- Petroleum -- its composition and occurrence
- Origin of Petroleum – Organic & Inorganic Theories;
- Source rocks – nature, types & characteristics
- Kerogen – composition & types

Unit- V

- Migration and Accumulation of Petroleum
- Reservoir Rocks;
- Reservoir Traps – Structural, Stratigraphic & Mixed Traps
- Salt Domes
- Oil shales, Shale gas

SEMESTER – III
PAPER: GEOL-M-303
SEDIMENTOLOGY (Elective Paper)

The pattern of question papers will be as under

Group A – Compulsory – ten questions (two from each unit) of 2 marks each,
 $2 \times 10 = 20$ marks

Group B –Five questions (one from each unit) of 5 marks each, four to be answered,
 $5 \times 4 = 20$ marks

Group C –Five questions (one from each unit) of 10 marks each, three to be answered
 $10 \times 3 = 30$ marks

Full Marks : 70

Unit-I

- Formation of Sedimentary rocks : Weathering and erosion, transportation, deposition and consolidation
- Texture of clastic sedimentary rocks : concept of grain size, grain morphology – roundness and sphericity, grain fabric; grade scales – Hopkins, Alterburg, Udden, Udden – Wentworth and Krumbein's scales, their merits & demerits.
- Porosity and Permeability : Primary and secondary, Darcy law
- Texture of non-clastic sedimentary rocks
- Graphical representation of analytical data and statistical analysis

Unit-II

- Sedimentary structures : Classification; primary inorganic structures – erosional, syn-depositional & deformational, chemical/diagenetic structures, biogenic structures and their significance

Unit-III

- Lithification and Diagenesis : Process of diagenesis,
- Diagenesis of sandstone
- Diagenesis of limestone

Unit-IV

- Classification of sedimentary rocks
- Sandstone – classification, type and origin,
- Limestone – classification, type & origin;
- Dolomitization and dedolomitization

Unit-V

- Provenance – Definition
Determination
Concept of maturity of sediments, mobility of oxides
Role of heavy minerals in provenance determination
- Heavy mineral assemblages

SEMESTER – III**PAPER : Geol-M- 304 (Practical)**

- Megascopic study of economic minerals
- Identification of vertebrates, invertebrates, plant fossils & microfossils.
- Identification of stratigraphic rocks of important stratigraphic horizons of India.
- Study of Palaeogeographic & stratigraphic maps of India for different geological periods.
- Field Report records & Viva-voce.

BOOKS RECOMMENDED

Economic Geology

- Facal, Z.. (ed), 1977 – **Geochemical Prospecting Methods**.
- Bateman – **Economic Geology**.
- Gilbert. J. M. and Park, Jr. C.F. – **The Geology of Ore Deposits**. Freeman.
- Mckinstry, H.E. – **Mining Geology**. IIED Asia Publishing House.
- Arogyaswami, R.P.N. – **Courses in Mining Geology**. IV ed. Oxford IBH
- Barroah, S.K. – **Economic Mineral Deposits of India**.
- Brown, C. and Dey, A.K. – **Indian Mineral wealth**.
- Edwards, H. and Atkinson, K. – **Ore Deposit Geology**.
- Sowking, F.J. – **Metal Deposits in relation to Plate Tectonics**.
- Evans, A.M. (1993) **Ore Geology and Industrial Minerals**, Blackwell
- Stanton, R.L. (1972) **Ore Petrology**, McGraw Hill
- Barnes, H.L. (1979) **Geochemistry of Hydrothermal Ore Deposits**, John Wiley
- Klemm, D.D. and Schneider, H.J. (1977) **Time and Strata Bound Ore Deposits**. Springer Verlag
- Gilbert, J.M. and Park, Jr. C. F. (1986) **The Geology of Ore Deposits**. Freeman
- Mookherjee, A. (2000) **Ore Genesis – A Holistic Approach**. Allied Publisher
- Wolf, K.H. (1976-1981) **Hand Book of Stratabound and Stratiform Ore Deposits**. Elsevier
- Ramdohr, P. (1969) **The Ore Minerals and their Intergrowths**. Pergamon Press
- Danbar, C.O. and Rodgers, J. (1957) **Principles of Stratigraphy**. John Wiley & Sons.

Stratigraphy

- Naqvi, S.M. and Rogers, J.J.W. (1987) **Precambrian Geology of India**. Oxford University Press
- Krishnan, M.S. (1982) **Geology of India and Burma**. C.B.S. Publishers & Distributors, Delhi
- Pascoe, E.H. (1968) **A Manual of the Geology of India & Burma** (Vols I-IV) Govt. Of India Press, Delhi
- Schoch, Robert, M. (1989) **Stratigraphy: Principles and Methods**, Van Nostrand Reinhold, New York
- Doyle, P. & Bennett. M.R. (1996) **Unlocking the Stratigraphic Record** (John Villey)
- Weller, J. Marvin (1960) **Stratigraphic Principles & Practice**, Harper & Row Publishers New York & London
- Wadia, D.N. **Geology of India**, Tata McGraw-Hill Publishing Co, N. Delhi
- Lemon Roy R. (1990) **Principles of stratigraphy**, Herrill Publishing Company
- Kumar Rabindra, **Fundamentals of Historical Geology and Stratigraphy of India**, wiley Eastern Ltd, N. Delhi
- Sharma, P.V., 1986, **Geophysical Methods in Geology**, Elsevier.
- Dobrin, M.B. 1976, **Introduction to Geophysical Prospecting**. McCraw Hill.
- Wolf, K.H., 1976-81 : **Hand Book of Stratabound and Stratiform Ore Deposits**. Elsevier.
- Klemm, D.D. and sohneider, H.J., 1977 – **Time and Strata Bound Ore Deposits**. Springer Verlag.

Palaeontology

Woods, H. – **Invertebrate Palaeontology**.

Eorley and Davis, A.M. – **Introduction to Palaeontology**

Swinerton, H.H. – **Outline of Palaeontology**.

Shrock, R. T. and Townshofel, W.H. – **Invertebrate Palaeontology**.

Lull – **Organic Evolution**.

Stearns, C.W. and Carroll, R.L., 1989 – **Palaeontology – the Record of Life**. John Wiley.

Romer, A.S., 1966; **Vertebrate Palaeontology** (3rd Edn.) Chicago Univ. Press.

Olson, E.C., 1971 – **Vertebrate Palaeozoology**. John Wiley.

Benton, M.J., 1990 – **Vertebrate Palaeontology**, Union Yman.

Arnold, C.A., 1947 – **An Introduction to Palaeobotany**. Mccrew will.

Andrews, Jr. Bell. 1961 – **Studies in Palaeobotany**. John Wiley.

Saward, A.e., 1931 – **Plant Life through the Ages**. Cambridge Univ. Press.

Hynes, J.R. 1981 – **Foraminifera**, John Wiley.

Bignot, G., 1985 – **Elements of Micropalaeontology**. Uraham and Trotman.

Boardman R.S., Cheethan. A.M. and Rowell. A.J. (1988) : **Fossil Invertebrates**. Blackwell.

Clarkson. E.N.K. (1998) : **Invertebrate Paleontology and Evolution**. Allen and Unwin, London.

Raup. D.M. and Stanley, S.M. (1985) : **Principles of Paleontology**. CBS Publ.

Smith. A.B. (19947) : **Systematics and Fossil Recored – Documenting Evolutionary Patterns**. Black well.

Shrock R.R. (1953) **Principles of Invertebrate Paleontology**, Mc Graw Hill Book co.

Adv. Hydrogeology (Elective)

Raghunath, H. M., **Ground Water**, New Age International Publishers;

Todd, D. K., **Groundwater Hydrology**, John Wiley & Sons;

Mandel, S. & Shiftan, Z. N., **Groundwater Resources : Investigations and Development** , Academic Press;

Manning, John C, **Applied Principles of Hydrology**, CBS Publishers;

LaMoreaux, Soliman, Memon & Assaad, **Environmental Hydrogeology**,

Grigg, Neil S, **Water Resources Management**, McGraw Hill;

Das & Saikia, **Hydrology**, PHI Learning Pvt Ltd ;

Handa, O.P., **Groundwater Drilling**, Oxford & IBH Publishing Co.;

Ravenscroft, Brammer & Richards, **Arsenic Pollution**, Willey- Blackwell;

Davies, S.N. and Dewiest, R.J.M. – **Hydrogeology**, John wiley.

Fetter, C.W. **Applied Hydrogeology**, Merill Publishing.

Karanth. K.R. – **Groundwater Assessment – Development and Management**. Tata Mc. Grew Hill.

Fuel Geology (Elective)

- Colin R. Ward (Edited), **Coal Geology and Technology**.
 Wilcon and Wells, **Coal, Coke and Coal chemical**
 Coggin Brown and A.K. Dey **Mineral and Nuclear Fuels of Indian Subcontinent** -.
 A. I. Levorsen, **Geology of Petroleum** .
 F.K. North, **Petroleum Geology**, (Publishers- Allen and Unwiry.)
Petroliferous Basins of India – 1993-94 (3 volumes), Indian Petroleum Publishers, Dehradun.
 Chendra, D. Singh, R.M. and Singh, M.P. 2000. **Textbook of Coal** (Indian Context). Tara Book Agency.
 Raranesi.
 Singh, M.P. (Ed.) 1998 – **Coal and Organic Petrology**. Publ. Corp. New Delhi.
 Holson, G.D. and Tiratsoo, E.N., 1985. **Introduction to Petroleum Geology**. Gulf Publ. Houston, Texas.
 Selley, R.C., 1998, **Elements of Petroleum Geology**. Academic Press.
 North, F.K., 1985, **Petroleum Geology**, Allen and Unwin.
 Tissot B.P. and Welge, D.L., 1986, **Petroleum Formation Occurrence** Springer Verlag.

Sedimentology (Elective)

- Pettijohn – F.J., **Sedimentary Rocks**,
 Selley, R.C., **Applied Sedimentology**, Academic Press
 Reineck, H.E. and Singh, I.B., **Depositional Sedimentary Environments**. Springer – Verlag.
 Tucker, M.E., **Sedimentary Petrology : An Introduction**, Wiley & Sons, New York
 Tucker, M.E, **Carbonate Sedimentology**, Blackwell Scientific Publication
 Reading, H.G., **Sedimentary Environments and Facies**, Blackwell Scientific Publication
 Blatt, H., Middleton, G.V. and Murray, R.C, **Origin of sedimentary Rocks**, Prentice – Hall Inc.
 Colling, J.D. and Thompson, D.B., **Sedimentary structures**. George Allen & Unwin, London.
 Miall, A.D. (2000) **Principles of Basin Analysis**, Springer – Verlag.
 Lindholm, R.C. (1987), **A practical Approach to Sedimentology**; Allen & Unwin, London
 Krumbein, W.C. and Pettijohn, F.J., **Manual of sedimentary Petrography**, D Appleton – Century
 Company, Inc.

SEMESTER – IV
PAPER : GEOL-M- 402
STRATIGRAPHY AND PALAEOONTOLOGY

The pattern of question papers will be as under

Group A – Compulsory – ten questions (two from each unit) of 2 marks each,
 $2 \times 10 = 20$ marks

Group B –Five questions (one from each unit) of 5 marks each, four to be answered,
 $5 \times 4 = 20$ marks

Group C –Five questions (one from each unit) of 10 marks each, three to be answered
 $10 \times 3 = 30$ marks

Full Marks : 70

Unit-I

Palaeozoic Stratigraphy

- Cambrian succession in Salt Range
- Age of Saline Series
- Cambrian of Spiti & Kashmir
- Muth Quartzite, Lipak and Po Series
- Permo-Carboniferous : stratigraphy and paleogeography
- Permian – Triassic (P-T) boundary

Unit-II

Mesozoic Stratigraphy

- Triassic formations of India
- Jurassic formations of Kutch
- Marine Transgressions ; Cretaceous formations of Trichonopoly
- Palaeogeography & Climate conditions during Gondwana/Cretaceous periods.

Unit-III

Caenozoic Stratigraphy

- Deccan Traps & Intertrappeans
- Tertiary formations of India
- Siwalik System- stratigraphy and evolution
- Cretaceous-Tertiary (K-T) Boundary

Unit-IVInvertebrate Palaeontology :

- Morphology and evolutionary trends in:
 - Brachiopods,
 - Molluscs- Gastropoda, Pelecypoda, Cephalopoda
 - Trilobites
 - Echinodermata
 - Graptolites,

Unit-V

- Vascular & Non-vascular plants
- Gondwana Flora in India.
- Fundamental ecological principles
- Marine Ecosystem; Fossil communities, Coral Reefs
- Introduction to Microfossil groups
- Sampling & processing techniques for microfossil studies
- Brief idea of Foraminifera & Radiolarians
- Application of microfossil studies in Correlation, Petroleum exploration, Palaeo-climate & oceanographic studies

SEMESTER – IV
PAPER : GEOL-M-403
ADV. HYDROGEOLOGY (Elective Paper)

The pattern of question papers will be as under

Group A – Compulsory – ten questions (two from each unit) of 2 marks each,
2×10 = 20 marks

Group B –Five questions (one from each unit) of 5 marks each, four to be
answered, *5×4 = 20 marks*

Group C –Five questions (one from each unit) of 10 marks each, three to be
answered *10×3= 30 marks*

Full Marks : 70

Unit I :

- Groundwater pollution : Municipal, industrial, agricultural and other sources;
- Attenuation of groundwater pollution;
- Groundwater quality in different provinces of India with special reference to Bihar;
- Problem of arsenic and fluoride contamination;
- Saline water intrusion in coastal and other aquifers and its prevention;

Unit II :

- Groundwater exploration : Geological, lithological and structural mapping, fracture, stress analysis;
- Surface geophysical methods- seismic, gravity, geo-electrical and magnetic.
- Subsurface geophysical methods- well logging for delineation of aquifers.
- Water level measurement;
- Test drilling

Unit III :

- Application of aerial photographs & Remote Sensing ;
- Photo interpretation; Stereoscopic photography; Mosaic;
- Hydrogeomorphic mapping of the terrain using images of different satellite missions;
- Shallow groundwater potential zones mapping using satellite images;

Unit IV :

- Water Conservation
- Rainwater Harvesting : catchment harvesting, harvesting structures,
- Check dams, percolation tanks;
- Artificial recharge;
- Conjunctive use of surface and subsurface water;
- Groundwater development in arid and semi-arid regions;
- Irrigation systems.

Unit V :

- Groundwater provinces of India with special reference to Bihar;
- Groundwater management in urban areas
- Groundwater management in rural areas;
- Groundwater problems related to foundation work, mining, canals and tunnels;
- Groundwater legislation;

SEMESTER – IV
PAPER : GEOL-M-403
FUEL GEOLOGY (Elective Paper)

The pattern of question papers will be as under

Group A – Compulsory – ten questions (two from each unit) of 2 marks each,
 $2 \times 10 = 20$ marks

Group B –Five questions (one from each unit) of 5 marks each, four to be answered,
 $5 \times 4 = 20$ marks

Group C –Five questions (one from each unit) of 10 marks each, three to be answered
 $10 \times 3 = 30$ marks

Full Marks : 70

Unit-I

- Coal Hydrogenation & Gasification;
- Coal combustion
- Coal as a source rock in petroleum generation; Oil Shales
- Coal Bed Methane (CBM)

Unit- II

- Geological & geographical distribution of Gondwana coals in India
- Jharia & Raniganj Coalfields;
- Tertiary coals – characteristics and coalfields of India
- Lignite deposits in India
- Coal Exploration & Coal Industry in India

Unit-III

- Fundamental concepts of Sequence Stratigraphy –
 - depositional sequence,
 - types, boundaries, flooding surfaces, system tracts,
 - aggradation, progradation, retrogradation etc.
- Seismic sequence stratigraphy
- Sequence stratigraphy and Basin Analysis

Unit-IV

- Elementary idea of well logging and drilling
- Methods of Petroleum Exploration- geological & geophysical
- Utility of microfossils in Oil exploration

Unit- V

- Petroliferous Basins of India
 - Digboi,
 - Cambay
 - Bombay High Basins
 - East coast basins
- Present investigations and future prospects of Oil and Gas in India

SEMESTER - IV
PAPER : GEOL-M-403
SEDIMENTOLOGY (ELECTIVE PAPER)

The pattern of question papers will be as under

Group A – Compulsory – ten questions (two from each unit) of 2 marks each,
 $2 \times 10 = 20$ marks

Group B –Five questions (one from each unit) of 5 marks each, four to be answered,
 $5 \times 4 = 20$ marks

Group C –Five questions (one from each unit) of 10 marks each, three to be answered
 $10 \times 3 = 30$ marks

Full Marks : 70

Unit-I

- Sedimentary Environment – Physical, chemical & biological parameters, Classification
- Study of characteristics of sediment fill of Aeolian, Fluvial, Glacial, Desert, Beach, Tidal flats, Estuary and Marine environments

Unit-II

- Sedimentary basins : Concept & Classification
- Sedimentation & Tectonics
- Concept of sedimentary facies association
- Study of Orthoquartzite-Carbonate, Molasse, Flysch, Euxenic, Red-Bed, Black shale & Sabkha facies
- Palaeocurrent analysis

Unit-III

- Application of modern methods & techniques in the study of sediments
- Sampling, principles & methods of size-analysis – Stoke's Law, Wadell's sedimentation formula, decantation, elutriation, sieving etc.
- Reynold's Numbers, Froude Number, Sedimentary Gravity flow.

Unit-IV

- Bearing of sedimentary petrography on palaeo-geographical problems
- Study of mass properties of sediments: Colour, specific gravity, porosity, permeability, plasticity, hygroscopicity, adsorption, & tensile strength

Unit-V

- Application of Sedimentology in
 - Petroleum geology
 - Geohydrology
 - Environmental geology
- Sedimentological study of
 - Vindhyan
 - Gondwana
 - Siwaliks

SEMESTER – IV

PAPER : GEOL-M-404 (Practical)

ADVANCE HYDROGEOLOGY (Elective Paper)

Full Marks -70

- Study of Hydrogeological maps,
- Study of groundwater conditions in different geological terrains of Bihar,
- Study of hydrological properties of water bearing materials:
- Estimation of pH, conductivity, hardness, chloride, carbonate, bicarbonate, arsenic, calcium and magnesium content in water samples,
- Plotting of groundwater provinces of India,
- Elementary idea of Resistivity meter and AAS,
- Viva-voce and sessional records.

PAPER : GEOL-M-404 (Practical)

FUEL GEOLOGY (Elective Paper)

Full Marks -70

- Methods of Sampling of coal
- Proximate analysis of coal – data problems
- Structural problems ; completion of outcrop in maps
- Calculation of coal reserves
- Determination of Specific gravity
- Drawing of isopach maps,
- Identification of important microfossils
- Distribution of various fuel / hydrocarbon resources on outline map of India,
- Study of geological maps, Isopach maps and sections of important oilfields of India,
- Viva-voce and sessional records.

PAPER : GEOL-M-404 (Practical)
SEDIMENTOLOGY (Elective Paper)
Full Marks -70

- Size analysis: Their graphical representation and determination of different statistical parameters,
- Shape analysis: Determination of roundness and sphericity and porosity in clastic and carbonate rocks,
- Megascopic and thin section studies of sedimentary rocks,
- Study of different sedimentary structures and their sedimentological significance,
- Thin section studies of heavy minerals,
- Determination of Eh and pH,
- Viva-voce and sessional records.