



University of Rajasthan Jaipur

SYLLABUS

M.Sc. GEOLOGY

(Annual Scheme)

M.A./M.Sc. (Previous) Examination 2021

M.A./M.Sc.(Final) Examination 2022

Raj / Jain

Dy. Registrar (Acad.)
University of Rajasthan
JAIPUR

SCHEME OF EXAMINATION

(Annual Scheme)

Each Theory Paper	3 Hrs. Duration	100 Marks
Dissertation/Thesis/ Survey Report/Field Work, if any.		100 Marks

2

NOTICE

The Ordinance governing the examinations in the Faculties of Arts, Fine Arts, Social Sciences, Science, Commerce and Law are contained in a separate booklet. Candidates are advised to refer to the same.

Changes in Statutes/Ordinances/Rules/Regulations/ Syllabus and Books may, from time to time, be made by amendment or re-making and a candidate shall, except as far as the University determines otherwise comply with any change that applies to years he has not completed at the time of change.

All court cases shall be subject to the jurisdiction of the Rajasthan University headquarter at Jaipur only and not any other place.

University of Rajasthan, Jaipur
 Published by Shiv Book Depot, Jaipur
 for University of Rajasthan
 Printed by Harish Printers, Jaipur

- The number of papers and the maximum marks for each paper/practical shall be shown in the syllabus for the subject concerned. It will be necessary for a candidate to pass in the theory part as well as in practical part (wherever prescribed) of a subject/paper separately.
- A candidate for a pass at each of the Previous and the Final Examinations shall be required to obtain :
 - Atleast 36% marks in the aggregate of all the papers prescribed for the examination, and
 - Atleast 36% marks in practical(s) wherever prescribed at the examination, provided that if a candidate fails to secure atleast 25% marks in each individual paper at the examination and also in the dissertation/Survey report/field work, wherever prescribed, he shall be deemed to have failed at the examination notwithstanding his having obtained the minimum percentage of marks required in the aggregate for that examination. No division will be awarded at the Previous and the Final Examination. Division shall be awarded at the end of the Final Examination on the combined marks obtained at the Previous and the Final Examination taken together, as noted below :

First Division	60%	} of the aggregate marks taken together of the Previous and the Final Examination.
Second Division	48%	

All the rest will be declared to have passed the examination

- If a candidate clears any Paper(s)/Practical(s)/Dissertation prescribed at the Previous and/or Final Examination after a continuous period of ~~two~~ years, then for the purpose of working

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2

in his division the minimum pass marks only viz. 25% (36% in practical) shall be taken into account in respect of (Practicals), Practica:(s)/Dissertation are cleared after the expiry of a period of three years; provided that in case where a candidate required more than 25% marks in order to secure the minimum aggregate as many mark out of those actually secured by him will be taken into account as would enable him to clear the deficiency in the requisite minimum aggregate.

Dissertation/Survey Report/Field Work shall be typed and submitted in triplicate so as to reach the office of the Head of Department at least 3 weeks before the commencement of the theory examination. Only such candidates shall be permitted to offer Dissertation/Field Work/Survey Report/Thesis (if provided in lieu of a paper as have secured 75% marks in the aggregate of all the papers prescribed in the previous examination in the case of annual scheme) in lieu of the number of papers in which a candidate actually appeared at the examination.

D) Non-eligible candidate are not eligible to offer dissertation as per provisions of O. 170-A.

M.Sc. (GEOLOGY)

Total Marks of M.Sc. Previous 600

Each of the following theory papers shall be of 60 marks

M.Sc. Previous

A. Theory Papers:

- Paper I : Mineralogy, Crystallography and Geochemistry
 Paper II : Environmental Geology, Geomorphology and Hydrogeology.
 Paper III : Structural Geology and Tectonics
 Paper IV : Palaeontology
 Paper V : Sedimentology and Principles of Stratigraphy
 Paper VI : Precambrian Geology and Stratigraphy of India

B. Practical and Fieldwork:

- Part-A 100
 Part-B 115 (This includes 25 marks of the field as mentioned in para 'D')

C. Seminar Presentation. 25 marks

Seminar presentation shall be evaluated by the following committee:

- (i) Head of Department
- (ii) Supervisor
- (iii) One member to be appointed by the Head on the basis of seniority.

D. Field Work :

- (i) Mapping 15 Marks
 (ii) Gen. Field Work 10 Marks

M.Sc. Final

Total marks of M.Sc. Final 625

A. Theory Papers of 75 Marks each

- Paper VII : Resource Geology
 Paper VIII : Igneous and Metamorphic Petrology
 Paper IX : Remote sensing and Exploration geology
 Paper X : Elements of Engineering Geology, Mining Geology and Ore Dressing

B. Paper XI : Project oriented Dissertation

Dissertation shall carry 100 marks and shall be evaluated by one external and the internal examiner

C. Practical : Part-A : 125 Marks

Part-B : 100 (This includes 30 marks of the field on mentioned in Para 'D')

D. Field Work : (i) Mining Training 15 Marks

(ii) Geo. Field Training : 15 Marks

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Academ

M.Sc. : GEOLOGY (PREVIOUS)

Section-I : Mineralogy, Crystallography and Geochemistry
 The paper will contain nine questions having three questions in each section. candidates are required to attempt five questions selecting at least one question from each section.

Section-A

Stereographic Projection and Gnomonic projection Thirty two point symmetry and their derivation. Twinning : type and laws. Bragg's law The powder and single crystal method. Dispersion of anisotropic media, interference colour, dispersion of light in biaxial crystals. Use of Universal stage.

Section-B

Crystal field theory and polymorphism, classification of silicates, study of optical properties of important rock forming minerals. Occurrence, chemical composition, crystal structure, experimental work, association of the following mineral families : Pyroxene, amphibole Garnet, Feldspar, Mica, Alumino-silicates and other important rock forming minerals.

Section-C

Isotopic diagrams - concept and application, trace and rare elements their abundance and application. Isotope Geochemistry. Radiometric isotopes - their application to geological systems. Rb-Sr, K-Ar, U-pb and Sm-Nd systematics.

Practical

Mineralogy:

1. Identification of minerals by microscopic examination.
2. Determination of optical characters of important rock forming minerals under microscope.

Crystallography:

1. Identification and description of crystal model in hand specimen.
2. Construction of stereographic projection and determination of crystal form in problems related to stereographic projections.
3. Crystal chemistry. Calculation of mineral formulae and presentation of chemical data.

Books Recommended:

- 1. *Mineralogy*, B.A. and Zussman J, 1996 The Rock Forming Minerals.
- 2. *Optical Mineralogy*, New York, McGraw Hill.
- 3. *Introduction to geochemistry*, Wiley Eastern.
- 4. *Manual of Mineralogy* John Wiley.
- 5. *Introduction to Mineral Sciences* Cambridge University.
- 6. *Mineralogical Phase Equilibria and Pressure - Temperature*, Mineralogical Society of America Publ.
- 7. *Laboratory Handbook of Petrographic Technique*, Wiley.

Paper-II : Environmental Geology, Geomorphology and Hydrogeology

Note: The paper will contain nine questions having three questions from each section. Candidates are required to attempt five questions in all selecting at least one question from each section

Section-A

Concept and definition of Environmental Geology; Major Ecosystem (Atmosphere, Biosphere, Hydrosphere and Lithosphere); Major environmental issues on global, regional and desertification. Natural hazards: risk perception, vulnerability zonation, adaptation and mitigation. Mineral and energy resources of India: their exploitation and impact on environment; Environmental Impact, Assessment; Environmental Management Plan, Environmental Audit, environmental regulations in India. Pollution and waste disposal; heavy metals and biogeochemical cycles; geological factors and human health. Concept of emerging Environmental Management System (EMS).

Section-B

Geomorphic processes and resulting landforms. Landforms : their types and relationship with structure and tectonics : their role in mineral and ground water exploration. Morphometry, slope, type and its development. Soil and its types; soil erosion and its conservation. Terrain evaluation for strategic purpose. Landforms of Thar desert.

Section-C

Ground water-its origin, types, importance, occurrence, movement and uses; ground water in hydrological cycle. Aquifer properties ground water flow and Darcy's law; geo-environmental control of ground water, ground water provinces in India with special reference to Rajasthan. Ground water pollution; ground water development and management; artificial recharge of ground water, ground water sustainability; basic concept of ground water modelling.

Practical

EIA and EMP formulation for mining, industrial and urban area. Delineation of vulnerable and hazardous zones; identification and siting of geologically safe habitation zone, safe waste disposal zone and rain water harvesting structures. Identification of present and past environment of deposition and accumulation of resources. Presentation of chemical analyses data and plotting of chemical classification diagram. Study and identification of seismic, flood and drought prone areas. Classification of ground water for use in drinking irrigation and industrial purposes, Watershed delineation. Morphometric analysis. Interpretation of ground water table and ground water contour maps. Plotting ground water basins of India.

Books Recommended:

- 1. *Valdiya K.S. 1987 Environmental Geology-Indian Context* Tata McGraw Hill.

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(4)

- Hobbs, B.E., Means, W.D. and Williams, P.F., 1967 An Outline of Structural Geology, John Wiley
- Davis, G.R., 1984 : Structural Geology of Rocks and Region, John Wiley.
- Ramsay, J.G. and Huber, M.I., 1987 : Modern Structural Geology. Vol. I and II, Academic Press.
- Price, N.J. and Cosgrove, J.W., 1990 : Analysis of Geological Structure Cambridge, Univ. Press.
- Bayly B., 1992 : Mechanics in Structural Geology, Springer Verlag.
- Ghosh S.K., 1995 : Structural Geology Fundamentals of Modern Developments, Pergamon Press.
- Moores, E. and Twiss, R.J., 1995 : Tectonics Freeman.
- Keary, P. and Vine, F.J., 1990 Global Tectonics Bickell.
- Storetvedt, K.N., 1997 : Our Evolving Planet : Earth's History in New Perspective Bergen (Norway), Alma Mater Forlag.
- Valdiya K.S., 1998 : Dynamic Himalya. Universities Press, Hyderabad
- Summerfield, M.A. 2000 : Geomorphology & Global Tectonics, Springer Verlag.

• Jackson, J.A. 1978 Environmental Geology, Gell & Howell USA
 • Hutchinson, T. 1983 Natural Hazards Cambridge University press
 • Kump, K. and AM 1999 The Dynamic Earth System Prentice Hall
 • Lal, R. 2001 Text Book in Environmental Science, Narosa International.
 • Lomenzo, J.E. 1980 Ground Water Hydrology, John Wiley
 • Lomenzo, J.E. & De Wiest R.J.M 1966 Hydrogeology John Wiley
 • Lomenzo, J.E. 1982 Ground Water Wiley Eastern
 • Lomenzo, J.E. 1987 Ground water Assessment - Development and Management. McGraw Hill
 • Lomenzo, J.E. 2000 Water Kingston Publication London
 • Lomenzo, J.E. 1988 Geomorphology
 • Lomenzo, J.E. 1969 Principles of Geomorphology, Wiley eastern New Delhi.

Paper-III : Structural Geology and Tectonics

Note: The paper will contain nine questions having three sections. In each section, candidates are required to attempt five questions in all selecting at least one question from each section.

Section-A

Mechanical principles and behaviour of rocks. Types of strain and stress ellipsoids Two dimensional stress analyses. Primary and secondary sedimentary structures and penecontemporaneous deformation.

Section-B

Faults and joints. Their nomenclature, age relationships, origin and significance. Causes and dynamics of faulting-normal, strike slip, thrust, Thrust/nappe.

Planar and linear fabrics in deformed rocks; their chronology and significance.

Concept of stereographic projection of fabric elements and its applications (β and π diagrams).

Section-C

Tectonic types. Shields, Platforms, Mountain chains, Rift valleys, Plateau tectonic ridges, Islands arcs and Ocean basins.

Tectonic theories; types and characteristics of Plate margins. Plate tectonic mountain belts and plate tectonics. Plate tectonics of Indian subcontinent with special reference to evolution of Himalayas and Gangetic plains.

Section-D

Resolution of structural problems by stereographic and orthographic projection. Structural analyses with stereonet.

Construction and interpretation of geological maps, outcrops and structural problems concerning economic mineral deposits.

Structural plotting of field data. Plotting and interpretation of structural data and resultant diagrams. Study of large scale tectonic features of the Earth.

Books Recommended:

- Jackson, J.A., 1965 Structure and Tectonics, Harper and Row
- Lomenzo, J.E., 1967 Folding and Fracturing of Rocks, McGraw Hill.

- Hobbs, B.E., Means, W.D. and Williams, P.F., 1967 An Outline of Structural Geology, John Wiley
- Davis, G.R., 1984 : Structural Geology of Rocks and Region, John Wiley.
- Ramsay, J.G. and Huber, M.I., 1987 : Modern Structural Geology. Vol. I and II, Academic Press.
- Price, N.J. and Cosgrove, J.W., 1990 : Analysis of Geological Structure Cambridge, Univ. Press.
- Bayly B., 1992 : Mechanics in Structural Geology, Springer Verlag.
- Ghosh S.K., 1995 : Structural Geology Fundamentals of Modern Developments, Pergamon Press.
- Moores, E. and Twiss, R.J., 1995 : Tectonics Freeman.
- Keary, P. and Vine, F.J., 1990 Global Tectonics Bickell.
- Storetvedt, K.N., 1997 : Our Evolving Planet : Earth's History in New Perspective Bergen (Norway), Alma Mater Forlag.
- Valdiya K.S., 1998 : Dynamic Himalya. Universities Press, Hyderabad
- Summerfield, M.A. 2000 : Geomorphology & Global Tectonics, Springer Verlag.

Paper-IV : Palaeontology

Note: The paper will contain nine questions having three questions from each section, candidates are required to attempt five questions in all selecting at least one question from each section.

Section-A

Evolution: mechanism, evidences and theories.

Classification : taxonomy and species nomenclature.

Paleoecology:

- (a) Fundamentals
- (b) Palaeoenvironment: physical parameters and various approaches of reconstruction.
- (c) Taphonomy, taphocoenosis, thanatocoenosis, time-averaging/condensation shell-beds and biostratigraphy.
- (d) Palaeoecological interpretation and its application

Section-B

Application of the following groups of fossils in stratigraphy and stratigraphic correlation/ reconstruction of palae environment:

Algae (Calcareous/Siliceous) : Coccolithophore, Stromatolites, Dinoflagellates, Halimeda, Diatoms, Pollen grains and spores, Foraminifers, Radiolarian, Sponges, Corals, Serpulids, Trilobites, Ostracodes, Monoplacophora, Gastropods, Nautiloids, Ammonoides, Belemnoides, Lamellibranchs (with functional morphology), Brachiopods (with functional morphology), Hyoliths, Bryozoans, Echinoids (with functional morphology), Crinoides, Graptolites and Conodonts.

Section-C

Ichthyology : Classification, description of common Ichthyogenera, application.

Gondwana Flora : Systematic study of important Gondwana Plants, bearing on palaeoclimate. Evolutionary history of man, elephant and horse.

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University of Rajasthan

Practicals:

Drawn sketches, classification, morphological description and distribution and locality of available macro-and micro-fossil specimens.

Study index fossils in their chronological order.

Study of functional morphology in fossil specimens.

Books Recommended:

- Smith, H. Palaeontology Invertebrate
- Sengupta, S.N.K., 1988 : Invertebrate palaeontology and Evolution. IV ed. Blackwell
- Steiner, C.W. & Carroll, R.L., 1989 : Palaeontology - The Record of Life John Wiley
- Smith, B., 1984 Systematics and the Fossils Records-Documenting Evolutionary Patterns, Blackwell.
- Sengupta, D.R., 1988 : Bringing Fossils to Life-An Introduction to Palaeobiology, McGraw Hill.
- Sengupta, R.S., Cneetham, A.H. and Rowell, A.J., 1987 : Fossil Invertebrates, Blackwell Science.
- Sengupta, R.S., Hillmer, G., 1983 : Fossil Invertebrates. Cambridge University Press.
- Sengupta, R.S. and Truker, V.C.T., 1985 : Palaeontology - An Introduction, Blackwell Press.
- Sengupta, R.S., 1986 : Trace Fossils - Biology, Taphonomy and applications, Blackwell & Hall
- Sengupta, R.S., 1987 : An Introduction to Palaeobotany, Tata McGraw Hill.
- Sengupta, R.S., 1980 : Elements of Palaeontology, John Wiley & Sons.
- Sengupta, R.S., 1984 : Evolution of the Vertebrates. Wiley Eastern Limited.

Paper-V : Sedimentology and Principles of Stratigraphy

Note: The paper will contain nine questions having three questions from each section, candidates are required to attempt five questions in all selecting at least one question from each section.

Section-A

Concept of sedimentation-process of transport, deposition, lithification and diagenesis.

Sedimentary environments and facies - Continental, alluvial, fluvial, desert-alluvial and glacial sedimentary system. Volcanoclastics, deep sea basins.

Texture of sedimentary rocks and their graphical representation, paleogeographic paleocurrents and basin analysis

Classification of sedimentary rocks

Section-B

Application of trace element, rare-earth element and stable isotope geochemistry of sedimentological problems. Description of following sedimentary rocks - conglomerate, sandstone, greywacke, shale, limestone, chert and evaporate. Tectonic frame work of sedimentary basins and their tectonic aspects.

Section-C

Order of stratigraphic nomenclature.

Standard stratigraphic scale and Indian equivalent.
Stratigraphic classification : Lithostratigraphy, biostratigraphy and chronostratigraphy and their units.
Sequence stratigraphy : concepts and application
Magnetostratigraphy
Climatostratigraphy
Graphic representation of stratigraphic data.

Practical**Books Recommended:**

- Friedman, O.M. and Sanders, J.E., 1978 : Principles of Sedimentology. John Wiley and Sons.
- Krumbein, W.C. and Sloss, L.L., 1963: Stratigraphy and Sedimentation. W.H. Freeman and Co., London.
- Pettijohn, F.J., 1984 : Sedimentary Rocks, CBS Publishers.
- Sengupta, S. 1997 : Introduction to Sedimentology. Oxford - IBH.

Paper-VI : Precambrian Geology and Stratigraphy of India

Note: The paper will contain nine questions having three questions from each section, candidates are required to attempt five questions in all selecting at least one question from each section.

Section-A

Early history of earth's Crust, nature of early crust, formation and evolution of greenstone, Granitic and granulitic terrains. Precambrian geochronology and early crustal evolution.

Precambrian provinces of India : Their stratigraphy and correlation. Precambrian world stratigraphy. Boundary problems in stratigraphy.

Section-B

Geology of Rajasthan - Archaen and Proterozoic rock groups. Banded Gneissic Complex, Aravalli, Delhi and Vindhyan Super-groups. Phanerozoic stratigraphy of Rajasthan including divisions, rock types, distribution, structure, correlation and economic significance.

Section-C

Nomenclature, division, rock types, distribution, structure, palaeogeography, flora, fauna, regional correlation and economic significance of the following groups in India:

(i) Palaeozoic (ii) Mesozoic and (iii) Cenozoic

Practical :

Description of important stratigraphic rocks and their order. Tracing of paleogeographic maps during Phanerozoic. Distribution of various geological formations on the outline map of India. Tectonic framework of India.

Books Recommended:

- M.S. Krishan (1966) Geology of India and Burma
- D.N. Wadia (1949) Geology of India
- Ramesh Kumar (1987) Stratigraphy of India.

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University of Rajasthan

6

- M. J. and Rogers, J.W. 1987 Precambrian Geology of India. Oxford
- H. 1968 A Manual of Geology of India and Burma Vol. IV Govt

studies of stratigraphical formations significant for paleontological and Sedimentological and visual environmental impact studies. The duration of field training be for three weeks. Geological mapping with emphasis on lithological, structural and geomorphological features. The duration of field training be for three weeks.

Attendance is compulsory and students not taking part in the training shall not be allowed to appear in the examination.

M. Sc. FINAL GEOLOGY

Paper - VII: Resource Geology

Note: The paper will contain nine questions having three question from each section, candidates are required to attempt five questions selecting at least one question from each section.

Section A

Magma and its relation with mineral deposit. The development of various theories of ore formation, Classification for ore deposits. Processes of ore formation: magmatic concentration, contact metamorphism, hydrothermal, Residual and mechanical concentration, sedimentation, metamorphism, supergene enrichment, Bacteriogenic, and volcanic gas exhalations, Stratabound and Stratiform ore deposits.

Fluid inclusion in ores : Principles, assumptions, limitations, and applications

Study of Stable and unstable isotopes in relation to ore deposits.

Section B

Mode of occurrence of ore bodies - morphology and relationship with host rocks. Textures, Paragenesis and Zoning of ore and their significance. Concept of ore bearing fluid and deposition of ore. Their origin, migration, Wall rock alteration, Structural and stratigraphic control of ore localization. Metallogenic provinces and epochs

Metallogenesis in relation to Plate tectonics. Metallic mineral resources in relation to mode of occurrence, use and distribution in India of Lead-Zinc, Aluminium, Iron, Manganese and Chromium.

Section C

Definition and origin of Coal, Rank grade and type of coal. Indian and International Classification Geological and geographical distribution of Coal deposits in India, Detailed geology for some coal bearing fields of India.

Oil and Gas. Its nature and composition. Origin and migration (primary and secondary) of Oil and gas. Characteristics of Reservoir rocks and traps (structural & stratigraphic) geology of oil bearing

basins of India, position of oil and natural gas in India, future prospects and the economic Scenario.

Atomic Fuel: Mode of occurrence Distribution of atomic minerals in India. Brief outline of the following important deposits; Bushveld chromite kuruko deposit iron Porphyry copper deposit.

Practical:

Megascopic study of structures and fabrics of different minerals and their associations. Mineralogical and textural studies of common ore minerals under ore-microscope and petrological study of other industrial and nonmetallic minerals. Diagrammatic representation of open cast and underground mining. Exercises on mine sampling and determination of tenor, cut-off grades and ore reserves

Books Recommended:

- Bateman, A.M. (1951), Economic Mineral Deposits.
- Brown, J.C. and A.K. Dey (1955) India's Mineral Wealth
- Sinha, R.K. and Geology of Ore Deposits
- Wolfe, J.A. (1984) Mineral Resources - A World Review
- Mookhejee, A., 2000 : Ore genesis - A Holistic Approach, Allied Publisher.

Paper VIII : Igneous & Metamorphic Petrology

Note : The paper will contain nine questions having three question from each section, candidates are required to attempt five questions in all selecting at least one question from each section.

Section A

Magma - Origin and emplacement; factors affecting magma generation, differentiation and Assimilation. Mineralogical, chemical and tectonic classification of igneous rocks; principles of IUGS systematics.

Crystallization of silicate melt-phase rule, crystallization behavior of albite-anorthite; albite-orthoclase; Forsterite-silica; Nephelene-Kalsilite-silica, Quartz-Albite-Anorthite-Orthoclase.

Section B

Petrography, mode of occurrence, classification and petrogenesis of granites, alkaline rocks, anorthosites, pegmatites, lamprophyre, basalt, ultramafic rocks and rocks suites

Metamorphism, its limits and variables. Phase rule and phase diagrams: ACF, AKF and AFM; their application in understanding mineral paragenesis and parentage.

Section C

Metamorphic zones, facies and grade, fabric and mode of occurrence of metamorphic rocks, Facies of low pressure (contact metamorphism) and of medium pressure metamorphism-greenschist, amphibolite and granulite. Facies of high pressure (eclogite and blue schist facies). Origin of migmatites in light of experimental studies. Origin of charnockites. Elements of Geothermometry, P-T paths of regionally metamorphosed rocks. Metamorphism and crustal evolution.

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7