



UNIVERSITY OF RAJASTHAN

JAIPUR

SYLLABUS

M.Sc. GEOLOGY

(ANNUAL SCHEME)

M.Sc. (Previous) Examination 2019

M.Sc. (Final) Examination 2020

**Dy. Registrar
(Academic)**

**University of Rajasthan
JAIPUR**

SCHEME OF EXAMINATION

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

NOTICE

Ordinance governing the examinations in the Faculty 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 in so 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.

1. 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.

2. A candidate for a pass at each of the Previous and the Final Examinations shall be required to obtain :

- (i) Atleast 36% marks in the aggregate of all the papers prescribed for the examination, and
- (ii) 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	} of the aggregate marks taken together of the Previous and the Final Examination.
Second Division	

All the rest will be declared to have passed the examination

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

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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
- (ii) Gen. Field Work

15 Marks
 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 One 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) Gen. Field Training : 15 Marks

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 Academ

... the minimum pass marks only viz. 25% (36% in practical) shall be taken into account in respect of Practica.(s)/Dissertation are cleared after the expiry of three years, provided that in case a candidate required more than 25% marks in order to secure a 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 Field Work/Survey Report/Thesis (if provided in lieu of a paper as have secured marks in the aggregate of all the papers prescribed for the previous examination in the case of annual scheme) if the number of papers in which a candidate actually appeared at the examination.

... candidates are not eligible to offer dissertation as per provisions of O. 170-A.

M.Sc. : GEOLOGY (PREVIOUS)

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

Section-A

Crystallographic Projection and Gnomonic projection Thirty two
questions concerning their derivation, Twinning type and laws,
Bragg's law, The powder and single crystal method
of anisotropic media, interference colour, dispersion
in biaxial crystals. Use of Universal stage.

Section-B

**Polymorphism and polymorphism, classification of silicates, study
of optical properties of important rock forming minerals
occurrence, chemical composition, crystal structure,
crystallographic 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 dating, K-Ar, U-Pb and Sm-Nd systematics
Practical**

Mineralogy:

**Classification of minerals by microscopic examination.
Determination of optical characters of important rock-forming
minerals under microscope.**

Crystallography:

**Classification and description of crystal model in hand specimen
Projection of stereographic projection and determination of
problems related to stereographic projections.
Crystallography. Calculation of mineral formulae and presentation.**

Books Recommended:

- 1. *Crystallography*, R.A. and Zussman J., 1996 - The Rock Forming Minerals
- 2. *Crystallography*, R.A. and Zussman J., 1996 - The Rock Forming Minerals
- 3. *Optical Mineralogy*, New York, McGraw Hill
- 4. *Crystallography*, C.B., 1991 Introduction to geochemistry, Wiley Eastern
- 5. *Handbook of Crystallography*, C.S., 993 - Manual of Mineralogy John Wiley
- 6. *Crystallography*, C.S., 1992 Introduction to Mineral Sciences Cambridge University
- 7. *Crystallography*, C.S., 1992 Introduction to Mineral Sciences Cambridge University
- 8. *Crystallography*, C.S., 1992 Introduction to Mineral Sciences Cambridge University
- 9. *Mineralogical Phase Equilibria and Pressure - Temperature*
- 10. *Mineralogical Phase Equilibria and Pressure - Temperature*
- 11. *Mineralogical Phase Equilibria and Pressure - Temperature*
- 12. *Laboratory Handbook of Petrographic Technique*

Paper-II : Environmental Geology, Geomorphology

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and Hydrogeology

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

**Concept and definition of Environmental Geology, Major
Ecosystem (Atmosphere, Biosphere, Hydrosphere and Lithosphere); Major
Major environmental issues on global, regional and Lithosphere);
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
rural 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**

**ELA and EMP formulation for mining, industrial and urban area
Delineation of vulnerable and hazardous zones; identification and
siting of geologically safe inhabitation 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. *Environmental Geology - Indian Context* Tata McGraw Hill
- 2. *Environmental Geology - Indian Context* Tata McGraw Hill
- 3. *Environmental Geology - Indian Context* Tata McGraw Hill
- 4. *Environmental Geology - Indian Context* Tata McGraw Hill

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• 1978 Environmental Geology, Gell & Howell USA
 • 1985 Natural Hazards Cambridge University press
 • 1989 The Dynamic Earth System Prentice Hall
 • 2001 Text Book in Environmental Science, Narosa International.
 • 1980 Ground Water Hydrology, John Wiley
 • & De West R.M 1966 Hydrogeology John Wiley
 • N.M 1982 Ground Water Wiley Eastern
 • 1987 Ground water Assessment - Development and Management.
 • Hill
 • V 2000 Water Kingston Publication London
 • 1988 Geomorphology
 • W.B 1969 Principles of Geomorphology, Wiley eastern New Delhi.

Paper-III : Structural Geology and Tectonics
 The paper will contain nine questions having three questions 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. Slip-solids. Two dimensional stress analyses. Primary and secondary structures and penecontemporaneous

Section-B
 Faults and joints. Their nomenclature, age relationships, origin and significance. Causes and dynamics of faulting-normal, strike slip, thrust and linear fabrics in deformed rocks; their chronology and significance.
 Concept of stereographic projection: of fabric elements and its application (β and π diagrams).

Section-C
 Mountain types. Shields, Platforms, Mountain chains, Rift valleys, oceanic ridges, Islands arcs and Ocean basins.
 Tectonic theories: types and characteristics of Plate margins. Plate tectonics and characteristics of Plate margins. Plate tectonics and characteristics of Plate margins. Plate tectonics and characteristics of Plate margins.

Application of structural problems by stereographic and orthographic projection. Structural analyses with stereonet.
 Interpretation of geological maps, outcrops and structural problems concerning economic mineral deposits. Plotting and plotting of field data. Plotting and interpretation of structural data and resultant diagrams. Study of large scale tectonic features of the Earth.

• 1965 Structure and Tectonics, Harper and Row
 • 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.
 • Moore, E. and Twiss, R.J., 1995 : Tectonics Freeman.
 • Keary, P. and Vine, F.J., 1990 Global Tectonics Blackell.
 • Storetvedt, K.N., 1997 : Our Evolving Planet : Earth's History in New Perspective Bergen (Norway), Alma Mater Forlag.
 • Vaidya K.S., 1998 : Dynamic Himalaya, Universities Press, Hyderabad
 • Summerfield, M.A. 2000 : Geomorphology & Global Tectonics, Springer Verlag.

Paper-IV : Palaeontology
 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 biostratonomy.
 (d) Palaeoecological interpretation and its application.

Section-B
 Application of the following groups of fossils in stratigraphy and stratigraphic correlation/ reconstruction of palaeo environment:
 Algae (Calcareous/Siliceous) : Coccolithophore, Stromatolites, Dinoflagellates, Halimeda, Diatoms, Pollen grains and spores, Foraminifers, Radiolarian, Sponges, Corals, Serpulids, Trilobites, Ostracodes, Monoplacophora, Gastropods, Nautiloids, Ammonoids, Belemnoides, Lamellibranchs (with functional morphology), Brachiopods (with functional morphology), Hyoliths, Bryozoans, Echinoids (with functional morphology), Crinoides, Graptolites and Conodonts.

Section-C
 Ichnology : Classification, description of common Ichnogenera, application.
 Gondwana Flora : Systematic study of important Gondwana plants, bearing on palaeoclimate. Evolutionary history of man, elephant and horse.

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

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

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Paper - VII: Resource Geology

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

Section A

Minerals and its relation with mineral deposit. The development of various theories of ore formation, Classification for ore deposits. Various types 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 inclusions 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 of host rocks. Textures, Paragenesis and Zoning of ore and their significance. Concept of ore bearing fluid and deposition of ore. Their distribution in different parts of the world. Wall rock alteration, Structural and stratigraphic control of ore localization. Metallogenic provinces and epochs

Study of various types of ore deposits in relation to Plate tectonics. Metallic mineral resources of India. Mode of occurrence, use and distribution in India of various types of ores: Lead-Zinc, Aluminium, Iron, Manganese and Chromium.

Section C

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

Oil and gas: Its nature and composition. Origin and migration of oil and gas (boundary) 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 either 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:

- Bherman, 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
- Wolf, J.A. (1984) Mineral Resources - A World Review
- Mookhejee, A., 2000 : Ore genesis - A Holistic Approach, Alliec 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, Nepheline-Kalsilite-silica, Quartz-Albite-Anorthite-Orthoclase.

Section B

Petrography, mode of occurrence, classification and petrogenesis of granites, alkaline rocks, anorthosites; pegmatites, lamprophyres, 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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Groundwater in tunnels, in hilly terrains. Landslides. Types, process
causes, remedial measures.

Section B

Elements of alluvial mining.

Advantages of open cast mining. Benching method, stripping, ratio,
overburden removal, advantages and disadvantages. Under ground
mining methods; Mine development, mine terminology, stopping
methods. Underground drilling machines, Explosives: their types and
uses. Blasting techniques, blast hole patterns, blast hole
distribution.

Methods of sampling, drill hole samples, chip and channel
sampling. Preparing samples for analysis.

Section C

Concept of ore dressing, its technical necessity. Physical
methods used in ore dressing.

Advantages of ore dressing. Comminution practice: Jaw, gyratory
crushers, their principle and uses; types of grinding mills.
Methods of sulfide beneficiation, concept of froth floatation.

Classification: sink - float techniques, gravity separation
methods. Process of coal washing. Heavy media separation,
electrostatic & Magnetic Separation.

Practical:

Survey by Plane Table and Prismatic Compass and Theodolite.
Levelling and countouring by Dumpy Level and profile drawing by
leveling level.

Books Recommended:

- *Practical Mining*, R.N.P. 1996 Courses in Mining Geology. Oxford IBH. Clark.
- *Practical Mining*, D.H. and Judd, W.R., 1998 Principles of Engineering Geology. CBS Publishers
- *Practical Mining*, P.V. 1997 Environmental and Engineering geophysics. Cambridge University Press.
- *Practical Mining*, K.V.G.K. 1980 Experiments in Engineering Geology. Oxford and IBH Publishing
- *Practical Mining*, S.K. 1986 Ore Processing Oxford and IBH Publishing

Field studies of outcrops of Igneous and Metamorphic rocks and
economic mineral deposits. The duration of field training should
be for three weeks.

Field training of mining methods with emphasis on geological
aspects of mineralization and mining. The duration of the
training should be for two weeks.

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



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