UNIVERSITY OF RAJASTHAN
JAIPUR

SYLLABUS

M.Sc. GEOLOGY

(ANNUAL SCHEME)

M.Sc. (Previous) Examination  2018
M.Sc. (Final) Examination  2019

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR
SCHEME OF EXAMINATION
(Annual Scheme)

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

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) At least 36% marks in the aggregate of all the papers prescribed for the examination, and
   (ii) At least 36% marks in practical(s) wherever prescribed at the examination, provided that if a candidate fails to secure at least 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% of the aggregate marks taken together of the Previous and the Final Examination.

   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
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:

<table>
<thead>
<tr>
<th>Paper</th>
<th>Subject</th>
</tr>
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<tbody>
<tr>
<td>I</td>
<td>Mineralogy, Crystallography and Geochemistry</td>
</tr>
<tr>
<td>II</td>
<td>Environmental Geology, Geomorphology and Hydrogeology</td>
</tr>
<tr>
<td>III</td>
<td>Structural Geology and Tectonics</td>
</tr>
<tr>
<td>IV</td>
<td>Palaeontology</td>
</tr>
<tr>
<td>V</td>
<td>Sedimentology and Principles of Stratigraphy</td>
</tr>
<tr>
<td>VI</td>
<td>Precambrian Geology and Stratigraphy of India</td>
</tr>
</tbody>
</table>

B. Practical and Fieldwork:

<table>
<thead>
<tr>
<th>Part-A</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part-B</td>
<td>115 (This includes 25 marks of the field as mentioned in para 'D')</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Paper</th>
<th>Subject</th>
</tr>
</thead>
<tbody>
<tr>
<td>VII</td>
<td>Resource Geology</td>
</tr>
<tr>
<td>VIII</td>
<td>Igneous and Metamorphic Petrology</td>
</tr>
<tr>
<td>IX</td>
<td>Remote sensing and Exploration geology</td>
</tr>
<tr>
<td>X</td>
<td>Elements of Engineering Geology, Mining Geology and Ore Dressing</td>
</tr>
</tbody>
</table>

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 |

B. Non-collegiate candidate are not eligible to offer dissertation as per provisions of O. 170-A.
M.Sc.: GEOLOGY (PREVIOUS)

Paper I: Mineralogy, Crystallography and Geochemistry

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

2. Optical sign of anisotropic media, interference, colour, dispersion, and birefringence in biaxial crystals. Use of Universal stage.

Section B

1. Minerals and polymorphism, classification of silicates, study of twins and optical properties of important rock forming minerals.
2. Methods of occurrence, chemical composition, crystal structure, experimental work, association of the following mineral families: Olivine, Pyroxene, Amphibole Garnet, Feldspar, Mica, Aluminosilicates and other important rock forming minerals.

Section C

1. Reaction diagrams - concept and application, trace and rare element, their abundance and application. Isotope Geochemistry, Application of radiogenic isotopes - their application to geological systems.
2. K-Ar, Rb-Sr, C, 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 angles in problems related to stereographic projections.
3. Geochemistry - calculation of mineral formula and presentation of empirical data.

Books Recommended:

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

1. 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


Section C

1. Ground water: its origin, types, importance, occurrence, movement and use; ground water in hydrological cycle. Aquifer properties, ground water flow and Darcy's law; geo-environmental control over 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

1. EIA and EMP formulation for mining, industrial and urban area. Delineation of vulnerable and hazardous zones; identification and zoning 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:
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 selecting at least one question from each section.

Section-A

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

Section-B

Fractures and joints. Their nomenclature, age relationships, origin and significance. Causes and dynamics of faulting-normal, strike slip, reverse thrust, nappe. Plane 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

Ophiolites, gabbros, shields, platforms, mountain chains, rift valleys, Mid oceanic ridges, islands and ocean basins. Tectonics theories and characteristics of plate margins. Tensional, compressional mountain belts and plate tectonics. Plate tectonics and recent sub-continent with special reference to evolution of Himalaya and Ganganic plains.

Practical


Books Recommended:
- Bayly, B., 1992 : Mechanics in Structural Geology. Springer Verlag
- Moores, E. and Twiss, R.J., 1995 : Tectonics Freeman
- Summerfield, M.A., 2000 : Geomorphology & Global Tectonics. Springer Verlag

Paper-IV : Palaeontology

Note: 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

Evolution of mechanism, evidences and theories.
Classification: taxonomy and species nomenclature.

Palaeocology:
(a) Fundamentals
(b) Palaeoenvironment: physical parameters and various approaches of reconstruction
(c) Taphonomy, thaphocrenosis, thanatocoenosis, time-averaging/condensation shell-beds and biostatigraphy
(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 (Calcareaous/Sileceous): Coccolithophore, Stromatolites, Dinoflagellates, Halimeda, Diatoms, Pollen grains and spores, Foraminifers, Radiolarians, Sponges, Corals, Serpulids, Trilobites, Ostracodes, Monomphalocophora, Gastropods, Nautiloids, Ammonoids, Belemnoids, Lamellibranchs (with functional morphology), Brachiopods (with functional morphology), Hyoliths, Bryozoaos, Echinoids (with functional morphology), Crinoids, Graptolites and Conodonts.

Section-C

Ichnology: Classification, description of common ichnotaxa and application.
Gondwana Flora : Systematic study of important Gondwana plants, bearing on palaeoclimate. Evolutionary history of man, elephant and others.
Practical:
Labeled sketches, classification, morphological description and age estimation of available macro-and micro-fossil specimens.
Study index fossils in their chronological order.
Study of functional morphology in fossil specimens.

Books Recommended:

Paper-VI: 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, dune sand and glacial sedimentary system. Volcanoclastics, deep sea basins.
Texture of sedimentary rocks and their graphical representation, structures 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 rock groups - conglomerate, sandstone, greywacke, shale, limestone, evaporite and evaporate. Tectonic frame work of sedimentary basins and their economic aspects.

Section-C
Code of stratigraphic nomenclature.

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

Practical
Books Recommended:

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 - Archaean and Proterozoic rock groups: Banded Geneissic Complex, Aravalli, Delhi and Vindhyian Super-groups. Phanerozoic stratigraphy of Rajasthan including divisions, rock types, distribution, structure, correlation and economic significance.

Section-C
Nomenclature, division, rock types, distribution, structure, palaeography, 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 paleo graphic maps during Phanerozoic. Distribution of various geological formations on the outline map of India. Tectonic framework of India.

Books Recommended:
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 chrome, kimberlite deposit iron, Porphyry copper deposit.

Practical:
Megascoptic 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), Economie Mineral Deposits.

Paper VIII: Igneous & Metamorphic Petrology
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
Magma - Origin and emplacement factors affecting magma generation, differentiation and assimilation. Mineralogical, chemical and textural classification of igneous rocks; Principles of IUGS systematic classification.

Crystalization of silicate melt-phase rules, crystallization behavior of plagioclase, olivine, olivine-plagioclase; Forsterite-silica, Nepheline-Kalsilite-silica, Quartz-Albite-Anorthite-Orthoclase.

Section B
 Petrography, mode of occurrence, classification and petrogenesis of granites, andesites, dacites, rhyolites, lamprophyres, basalt, ultramafic rocks and ophiolites.
Metamorphism, its limits and variables. Phase rules and phase diagrams of ACF, AKF and AFM; their application in understanding mineral paragenesis and parentage.

Section C

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Practical:

Igneous Petrology
- Description and identification of important igneous rocks in hand specimen and thin section.
- Graphical presentation of geochemical data and its interpretation.
- Calculation of CIPW and Niggli values. Geographic distribution of important igneous episodes of India.

Metamorphic Practical
- Description and identification of important metamorphic rocks in hand specimen and thin section.
- Graphical presentation of geochemical data - ACF and AKF diagram and their interpretation.
- Geographic distribution of important metamorphic terrains of India.

Books recommended:

Paper IX: Remote sensing and exploration geology
- 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

Application of geology in planning, designing and construction of civil engineering projects. Engineering properties of rocks: specific gravity, porosity, absorption, compressive and shear strength.

Rocks as construction material: previous and impervious soils, aggregates.


Section C

Elements of ore search and ore guides; surface prospecting methods: exploratory drilling, drill hole logging, deviation of bore holes; Geochronological prospecting, concept of anomaly, Geochronological cycle, mobility and association of elements, Geochemical tracers and isotopes. Primary and Secondary dispersion patterns, Geophysical prospecting - concept and application of seismic, gravity, magnetic, electrical and radioactivity methods. Classification of reserves; calculation of resources grade and tonnage relationship.

Practical:
- Familiarity with photogeology and satellite data products.
- Familiarity with photogeology and satellite data interpretation instruments.

Transfer of principal and conjugate points, determination of scale, interpretation of aerial photographs and satellite data for various applications such as hydrogeomorphology, geomorphology, geology, and land use & land cover, drainage and gully pattern, soil type identification, urban planning and environmental studies.
- Numerical and map interpretation of seismic, gravity, magnetic and electrical data.

Books recommended:
- Drony S.A. 1987 Image Interpretation in Geology Allen and Unwin.
- Paper X: Element of Engineering Geology.

Mining Geology and ore Dressing
- 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

Application of geology in planning, designing and construction of civil engineering projects. Engineering properties of rocks: specific gravity, porosity, absorption, compressive and shear strength.

Rocks as construction material: previous and impervious soils, aggregates.

Groundwater in tunnels, in hilly terrains. Landslides: Types, process leading to landslides, landslide prevention and remedial measures.

Section B

Elements of alluvial mining.
Cuttings 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 handling. Blasting techniques, blast hole patterns, blast hole examination.

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

Section C

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

Advantages of ore dressing. Comminution practice: Jaw, gyratory and cone crushers, their principle and uses; types of grinding mills.

Methods of sulfide beneficiation, concept of forth flotation.

Practical:
Survey by Plane Table and Prismatic Compass and Theodolite.
Leveling and contouring by Dumpy Level and profile drawing by level.

Books Recommended:

- Gurna, P.V. 1997 Environmental and Engineering geophysics. Cambridge Univ. Press.
- Hesse, K.V. 1980 Experiments in Engineering Geology

Field Training:

1. Field studies of outcrops of igneous and Metamorphic rocks and economic mineral deposits. The duration of field training should be for three weeks.
2. Field training of mining methods with emphasis on geological controls of mineralization and mining. The duration of the training should be for two weeks.

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

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