UNIVERSITY OF RAJASTHAN

JAIPUR

SYLLABUS

M.Sc. GEOLOGY

(ANNUAL SCHEME)

M.Sc. (Previous) Examination 2018

M.Sc. (Final) Examination 2019

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University of Rajasthan
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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. The students are advised to refer to the same.

Changes in Statutes/Ordinances/Rules/Regulations/ Syllabi 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

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SCHEME OF EXAMINATION

(Annual Scheme)

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

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	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.

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

The Thesis Dissertation/Survey Report/Field Work shall be type-written and submitted in triplicate so as to reach the office of the Registrar at least 3 weeks before the commencement of the theory examinations. Only such candidates shall be permitted to offer Dissertation/Field Work/Survey Report/Thesis (if provided in the scheme of examination) in lieu of a paper as have secured atleast 55% marks in the aggregate of all the papers prescribed for the previous examination in the case of annual scheme irrespective of the number of papers in which a candidate actually appeared at the examination.

B. Non-collegiate 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 Tectionics
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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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

Stereographic Projection and Gnomonic projection. Thirty two classes of symmetry and their derivation. Twinning : type and laws, X-ray diffraction, Brags law. The powder and single crystal method. Optic sign of anisotropic media, interference colour, dispersion and pleochroism in biaxial crystals. Use of Universal stage.

Section-B

Isomorphism and polymorphism, classification of silicates, study of physical and optical properties of important rock forming minerals. Mode of occurrence, chemical composition, crystal structure, experimental work, association of the following mineral families: Olivine, Pyroxene, amphibole Garnet, Feldspar, Mica, Alumino-silicates and other important rock forming minerals.

Section-C

Variation diagrams - concept and application, trace and rare earth elements, their abundance and application. Isotope Geochemistry, Stable and radiogenic isotopes - their application to geological systems especially 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 application in problems related to stereographic projections.

Geochemistry : Calculation of mineral formulae and presentation of analytical data.

Books Recommended:

- Deer, W.A., Howie, R.A. and Zussman J., 1996 : The Rock Forming Minerals. Longman.
- Kerr, P.F., 1997 : Optical Mineralogy, New York, McGraw Hill.
- Mason, B. & Moore, C.B., 1991 Introduction to geochemistry, Wiley Eastern.
- Klein, C. & Cornelius Hurbut, Jr. C.S., 1993 : Mannual of Mineralogy John Wiley.
- Putnis, Andrew, 1992 : Introduction to Mineral Sciences. Cambridge University Press.
- Spear, F.S., 1993 : Mineralogical Phase Equilibria and Pressure - Temperature - Time Paths, Mineralogical Society of America Publ.
- Hutchinson, C.S., 1974 : Laboratory Handbook of Petrographic Technique John Wiley.

Paper-II : Environmental Geology, Geomorphology 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, Bioshpere, 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 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:

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

- [illegible] E.A. 1978 Environmental Geology, Gell & Howell USA
- Bryant E 1985 Natural Hazards Combridge University press
- Easterbrook AM 1999 The Dynamic Earth System Prentice Hall
- Subramanyam V 2001 Text Book in Environmental Science, Narosa International.
- Todd D.K. 1980 Ground Water Hydrology, John Wiley
- Davis SN & De Wiest RJM 1966 Hydrogeology John Wiley
- Raghunath HM 1982 Ground Water Wiley Eastern
- Karanth KR 1987 Ground water Assessment - Development and Management. Tata Mc Graw Hill
- Karanthanam V 2000 Water Kingston Publication London
- Singh A. 1988 Geomophology
- Thornbury WB 1969 Principles of Geomorphology, Wiley eastern New Delhi.

Paper-III : Structural Geology and Tectonics

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

Mechanical principles and behaviour or rocks. Types of strain ellipse and 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.

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

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

Section-C

Crustal types, Shields, Platforms, Mountain chains, Rift valleys, Mid oceanic ridges, Islands arcs and Ocean basins.

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

Practical:

Solution of structural problems by stereographic and orthographic projections. Structural analyses with stereonet.

Preparation and interpretation of geological maps, outcrops and sections. Structural problems concerning economic mineral deposits. Recording and plotting of field data. Plotting and interpretation of petrofabric data and resultant diagrams. Study of large scale tectonic features of the Earth.

Books Recommended:

- Badgley PC., 1965 : Structure and Tectonics. Harper and Row.
- Ramsay JG, 1967 : Folding and Fracturing of Rocss. 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 : Gemorphology & Global Tectonics, Springer Verlag.

Paper-IV : Palaentology

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 biostrationmy.

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

Section-C

Ichnology : Classification, desription of common Inchnogenera, application.

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

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Practical:

Labelled sketches, classification, morphological description and age horizon 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:

- Moore, R. Palaeontology Invertebrate.
- Clarkson, E.N.K., 1988 : Invertebrate palaeontology and Evolution. IV ed. Blackwell.
- Stanley, C.W. & Carroll, R.L., 1989 : Palaeontology - The Record of Life John Wiley.
- Smith, A.B., 1984 : Systematics and the Fossils Records-Documenting Evolutionary Patterns, Blackwell.
- Prothero, D.R., 1988 : Bringing Fossils to Life-An Introduction to Palaeobiology, McGraw Hill.
- Boardman, R.S., Cheetham, A.H. and Rowell, A.J., 1987 : Fossil Invertebrates, Blackwell Science.
- Hallam, C., Hillmer, G., 1983 : Fossil Invertebrates. Cambridge University Press.
- Raup, E.M and Truker, V.C.T., 1985 : Palaeontology - An Introduction, Longman Press.
- Seilacher, A.C., 1986 : Trace Fossils - Biology, Taphonomy and applications, Chapman & Hall.
- Chaloner, A.A., 1987 : An Introduction to Palaeobotany, Tata McGraw Hill.
- Lehmann, 1980 : Elements of Palaeontology, John Wiley & Sons.
- Colbert, E.H., 984 : Evolution of the Vertebrates. Wiley Eastern Limited.

Paper-V : Sedimentology and Principles of Statigraphy

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-alien and glacial sedimentary system. Volcanoclastics, deep sea basins.

Texture of sedimentary rocks and their graphical representation, structures palaeocurrents 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, phosphorite 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

Graphic representation of stratigraphic data.

Practical

Books Recommended:

- Friedman, G.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.
- Pettijchn, 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 Geneissic Complex, Aravalli, Delhi and Vindhyan Supergroups. 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 palec graphic maps during Phenerozoic. 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.
- A.K. Rajinder Kumar (1982) Stratigraphy of India.

- [illegible] and Rogers, JJW. 1987: Precambilan Geology of India. Oxford [illegible]
- [illegible] H. 1968 A Manual of Geology of India and Burma Vol. I, IV Govt [illegible] Press

Field Training

1. Field studies of stratigraphical formations significant for plaeontological and Sedimintologigcal and visual environmental impact studies. The duration of field training be for three weeks.
2. Geological mapping with emphasis or liothological, structural and geomoporphological features. The duration of field training should be for three weeks.

Field 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

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

Section A

Magma and its relation with mineral deposit. The development of the modern 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 volcanogenic 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 of 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 deposits: Origin, mode of occurrence, use and distribution in India of Gold, Copper, Lead-Zinc, Aluminium, Iron, Managese and Chromium.

Section C

Coal: 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 important Coalfields of India.

Petroleum: 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 ecomomic Secnario.

Atomic Fule: 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 geneais - A Holostic 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, differentation 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; Naphelene-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 roks 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, amophibolite and granulite. Facies of high pressure (ecologite and blue schist facies). Origin of migmaties in light of experimental studies. Origin of charnockites. Elements of Geothermometry, P-T paths of regionally metamorphosed rocks. Metamorphism and crustal evolytic

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Practical:

Igneous Petrology

Description and identification of important igneous rocks in hand sepcimen and thin section.

Graphical presentation of geochemical data and its intrepretation.

Calcutaion of CIPW and Niggli values. Geographic distribution of important ingeous epoisodes of India.

Metamorphic Practical

Description and identification of imoportant metamorphic rocks in hand sepcimen 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

- Turner, FJ. 1980 : Metamorphic Petrology. McGraw Hill, New York.
- Yardley, B.W. 1989 An Introduction to Metamorphic Petrology. Longman, New York.
- Bucher K. and Frey, M. 1994 : Petrogenesis of Metamorphic Rocks. Springer Verlag
- Philpotts, A. 1992 : Igneous and Metamorphic Petrology Prentice Hall.
- Best M.G. 1986 : Igneous and Metamorphic Petrology, CBS Publishers.
- Bose, M.K. 997 Igneous Petrology, Worls Press, Kolkata.
- Krishnakar Rao : Metamorphic Petrology.
- Sen, K.G. Bel, J.D. and Pankhurst, R.J. 1979 : The Interpretation of Igneous Rocks Unwin Hyman.
- Winter, M 1989 : Igneous Petrogenesis.

Paper-IX : Remote sensing and exploration geology

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

Photogeology, Photogrammetry : types and geometry of Aerial Photograph, Map and Aerial Photographs; Photographic Flight Mission; Stereoscopy, Vertical Exaggeration; Elements of Aerial Photo-interpretation; Photomosaic, application of Aerial Photographs in Geology, Geomophology, Mineral & Petroleum Exploration, Water Resource Management, Urban Planning, Geo-Engineering and Environmental Studies.

Section B

Remote Sensing - Definition, Development in Remote Sensing in India and Abroad; Principles or Remote Sensing, Physical basis of Remote Sensing; Data Products; Visual Interpretation of Remote Sensing Data; Remote Sensing application in Mineral Exploration, Ground water exploration, Water Resource Management, soil studies, land use & land cover studies, Natural Hazard Management and Environmental Studies; Elements of Digital Interpretation; Basics of Geographic Information System. (GIS)

Section C

Elements of ore search and ore guides; surface prospecting methods; exploratory drilling; drill hole logging, deviation of bore holes; Geochemical propecting, concept of anomaly, Geochemocal 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 indetification, urban planning and environmental studies.

Numerical and map interpretation of seismic, gravity, magnetic and electrical data.

Book recommended

- Miller V.C. 1961 Photogeology McGraw hills.
- Sabbins F.F. 1985 Remote Sensing - Principles and Applications Freeman.
- Drury S.A. 1987 Image Interpretation in Geology Allen and Unwin
- Drury S.A. 1987 Image and Application of Photogeology Wiley Eastern, New Delhi.
- Wolf P.R. 1974 Elements of Photogrammetry McGraw Hill
- Sharma PV 1986 Geophysical Methods in Geology Elsevier
- Dobrin M.B. 1976 Introduction to Geophysical Prospection, McGraw Hill.
- Arogysawami RNP 1980 Courses in Minning Geology, Oxford, New Delhi

Paper-X : Element of Engineering Geology, Mining Geology and ore Dressing

Note : The paper will contain nine questions having three question from each section, candidates are required to attempt five question 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 imprevious soils, aggregates.

Dams : classification, terminology, types of spillways, Forces acting on dams, Geological investigations for dam site selection; geological mapping, trial pits, drilling, geophysical methods, their interpretation. Dam failure, leakage, sliding and settlement. Foundation treatment, grouting. Tunnels : classification and nomenclature, geological exploration for tunnel alignment, tunnel supports and lining.

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

Section B

Elements of alluvial mining.

Outlines of open cast mining, Benching method, stripping, ratio, overburden removal, advantages and disadvantages. Under ground mining methods; Mine development, mine terminology, stopping method. 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 griding mills. Methods of sulfide beneficiation, concept of forth 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. Leaveling and countouring by Dumpy Level and profile drawing by these level.

Books Recommended :

- Arogyaswamy, R.N.P. 1996 Courses in Mining Gology. Oxford IBH. Clark, G.B. 1967 Mining Geology. John Wiley.
- Krynine, D.H. and Judd, W.R., 1998 Principles of Engineering Geology. CBS Publishers.
- Sharma, P.V. 1997 Environmental and Engineering geophysics. Cambridge Univ. Press.
- Venkate K.V.G.K. 1980. Expenments in Engineering Geology.
- Jain S.K. 1986. Ore Processing Oxford and IBH Publishing.

Field Training :

1. Field studies of outcrops of Igneous and Matamorphic 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 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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