UNIVERSITY OF RAJASTHAN
JAIPUR

SYLLABUS

M.SC. GEOLOGY

Semester Scheme

I/II Semester Examination 2018-19
III/IV Semester Examination 2019-20
M.Sc. Geology
Course structure

Semester 1 –

<table>
<thead>
<tr>
<th>S. No.</th>
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<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>GEL 101</td>
<td>Mineralogy, Crystallography &amp; Geochemistry</td>
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<tr>
<td>2.</td>
<td>GEL 102</td>
<td>Invertebrate &amp; Vertebrate Palaeontology, &amp; palaeobotany</td>
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<td>3.</td>
<td>GEL 103</td>
<td>Principles of Stratigraphy &amp; Precambrian Stratigraphy</td>
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<td>4.</td>
<td>GEL 111</td>
<td>Lab.–I Mineralogy, Crystallography, Geochemistry, Palaeontology, Stratigraphy &amp; Field Training*</td>
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<td>1.</td>
<td>GEL A01 Sequence Stratigraphy</td>
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<td>2.</td>
<td>GEL A02 Palaeoecology</td>
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<td>3.</td>
<td>GEL A03 Geomorphology &amp; Remote Sensing</td>
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<td>GEL A04 Lab.—I Remote Sensing, Palaeoecology &amp; Geomorphology</td>
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<td>Crustal Evolution &amp; Phanerozoic Stratigraphy</td>
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<td>GEL 202</td>
<td>Structural Geology &amp; Tectonics</td>
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<td>GEL 203</td>
<td>Applied Palaeontology &amp; Micropalaeontology</td>
<td>CCC</td>
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<td>4.</td>
<td>GEL 211</td>
<td>Lab.-I Stratigraphy, Structural Geology, Palaeontology &amp; Field Training*</td>
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<td>GEL B01</td>
<td>Isotope Geology</td>
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<td>GEL B02</td>
<td>Oceanography and Palaeoclim ate</td>
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<td>GEL B03</td>
<td>Gemology &amp; Dimension stones</td>
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<td>4.</td>
<td>GEL B04</td>
<td>Lab.—I Gemology, Isotope geology &amp; Palaeoclim ate</td>
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<tr>
<td>1.</td>
<td>GEL 301</td>
<td>Mineral exploration &amp; Mining Geology</td>
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<td>2.</td>
<td>GEL 302</td>
<td>Igneous Petrology</td>
<td>CCC</td>
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<td>3.</td>
<td>GEL 303</td>
<td>Sedimentary Petrology</td>
<td>CCC</td>
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<td>4.</td>
<td>GEL 311</td>
<td>Lab.-I. Igneous and Sedimentary Petrology &amp; Field Training*</td>
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<td>GEL C01</td>
<td>Desert Geology</td>
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<td>GEL C02</td>
<td>Coal and Petroleum Geology</td>
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<td>Geotechnical Engineering</td>
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<td>GEL C04</td>
<td>Lab.—I. Coal and Petroleum Geology &amp; Desert Geology</td>
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<td>GEL 401</td>
<td>Metamorphic Petrology</td>
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<td>GEL 402</td>
<td>Resource Geology</td>
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<td>GEL 403</td>
<td>Environmental Geology &amp; Hydrogeology</td>
<td>CCC</td>
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<td>4.</td>
<td>GEL 411</td>
<td>Lab.-I Metamorphic Petrology, Resource Geology, Environmental Geology &amp; Field Training*</td>
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<td>GEL D01</td>
<td>Disaster Management</td>
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<td>GEL D02</td>
<td>Geoinformatics</td>
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<td>GEL D03</td>
<td>Ground water exploration &amp; Management</td>
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<td>GEL D04</td>
<td>Lab.-I Groundwater exploration, Geoinformatics and Disaster Management</td>
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Mineralogy, Crystallography & Geochemistry

Unit- I
Working principle of petrological microscope, Optical properties of minerals, Optical accessories and their use, Uniaxial and biaxial minerals, interference figures

Unit- II
Chemical composition, crystal structure, P-T stability, physical and optical properties and mode of occurrence of pyroxene, amphibole, mica and feldspar group of minerals

Unit- III

UNIT - IV
Concept and application of binary and ternary variation diagrams – Major, Trace and Rare Earth Elements and their application in provenance studies, tectonic environment and petrogenesis. Isotope geochemistry: Radiogenic and stable isotope.
Invertebrate & Vertebrate Palaeontology & Palaeobotany

Unit-I

Geological history and application of Lamellibranchs (with functional morphology), Gastropods, Nautiloids, Ammonoides, Belemnites, Brachiopods (with functional morphology), corals and Sponges in stratigraphy and stratigraphic correlation/reconstruction of palaeoenvironment.

Unit-II

Application of the following groups of fossils in stratigraphy and stratigraphic correlation/reconstruction of palaeoenvironment: Trilobites, Monoplacophora, Graptolites, Hyoliths, Bryozoans, Echinoids (with functional morphology), Crinoides.

Unit-III


Unit-IV

Outline of classification of vertebrates, significance of vertebrate palaeontology, sequence of vertebrates through geological ages. Evolutionary history of man, elephant and horse. Classification, significance and extinction of Dinosaurs.
Principles of Stratigraphy & Precambrian Stratigraphy

Unit-I


Unit II

Distribution, stratigraphic correlation, succession, geochronology and economic importance of Archean and Paleoproterozoic rocks of India; Dharwar Province, Eastern Ghat Province, Central Indian Province and Singhbhum-Orissa Province

Unit-III

Meso- and Neoproterozoic rocks in India; Cuddapah-Kurnool, Kaladgi, Bhima, Pakhal and Vindhyan basins: Distribution, stratigraphic correlation, succession and economic importance

Unit -IV

Precambrian geology of Rajasthan; Banded Gneissic Complex (Bhilwara Supergroup), Aravalli Supergroup, Delhi Supergroup, Marwar Supergroup, Vindhyan Supergroup and Malanl Igneous Suite
M. Sc. GEOLOGY FIRST SEMESTER

Practical

Gêl 111

Duration: 4 hours

Max. Marks 100

Mineralogy & Crystallography

1. Determination of axial ratio.
2. Identification of minerals in hand specimen.
3. Microscopic properties of minerals, identification of interference figures and optical sign, determination and measurement of 2V.
4. Graphical presentation and interpretation of geochemical data.

30 Marks

Palaeontology

Labeled sketches, classification, morphological description, and age/horizon and locality macro- and micro-fossil specimens. Study of index fossils in their chronological order.

20 Marks

Precambrian Stratigraphy:

1. Identification, description and geochronology of Indian Precambrian stratigraphic rocks.
2. Precambrian Stratigraphic maps of India.
3. Precambrian Palaeogeographic maps of India.
4. Graphical representation of stratigraphic sections (Litholog)

10 Marks

Field Training Program: Geological Mapping Training – 10 days duration.

10 Marks

15 marks

15 Marks

All training is compulsory. Student not taking part in the field training shall not appear in the examination

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Sequence Stratigraphy

Unit -I


Unit -II


Unit -III


Unit -IV

System of Sequences and Sequence Boundaries - Hierarchy System Based on Cycle Duration frequency), Hierarchy System Based on the Magnitude of Base-Level Changes

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Palaeoecology

Unit- I

Palaeoecology: introduction, ecosystem, aspects, difference with modern ecology Biocoeno Taphonomy, Taphocoenosis, Thanatocoenosis, Time averaging. Scope

Unit- II

Requisites of fossilization. Principle of Uniformitarianism. Subdivision of aquatic environme Environmental parameters

Unit- III


Unit- IV

Trace fossils: Introduction, classification, morphology, their significance in Palaeoecology Interpretation. Various approaches to reconstruct the palaeoenvironment.
Unit- I

Basic principles of Geomorphology, Weathering and erosion pathogenesis; mass movement, erosion, transportation and deposition. Types of landforms: fluvial, glacial, Aeolian, coastal and karst. Tectonics and Landforms. Tectonic subdivision of India.

Unit- II

Geomorphic mapping- tools and Techniques, slope studies, drainage and basin analysis. Application of geomorphology in mineral prospecting, civil & defense engineering and environmental studies.

Unit- III

Fundamentals of remote sensing; Physical Basis of Remote Sensing, remote sensing systems; space platforms and orbit patterns; remote sensing sensors; thermal, radar and hyperspectral images; signatures of rocks, minerals and soils. Elements of Remote Sensing Interpretation.

Unit- IV

Fundamental principles and technology of aerial photography and its applications in geosciences. Photogrammetry, types & geometry of aerial photographs; factors affecting aerial photography; scale of aerial photography and factors affecting scale; relief displacement; vertical exaggeration; Stereoscopy; Elements of Photo Interpretation.
M. Sc. GEOLOGY FIRST SEMESTER

Practical

Gel AO4

Max. Marks 100

Duration: 4 hours

Sequence Stratigraphy

Identification of sedimentary rocks (Rudstone, Shell-beds, sandstone, siltstone, Shale) and their probable assignment to different system tracks; TST, MFZ, HST. Determine sequence boundaries and Third order cycles in the given litho-log. Draw fence diagram based on different litho-logs of a sedimentary basin.

Palaeoecology

25 marks

Palaeoecological analysis: Quantitative and Taphonomic analysis: species diversity, trophic composition, cluster analysis. Interpretation of data

Geomorphology

25 Marks

Identification and description of various landforms, Morphometric analysis of drainage basins, Studies of drainage patterns and Exercises on Slope analysis.

Remote Sensing:

25 Marks


Viva-Voce Record

10 Marks

15 Marks

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<th>EoSE duration (Hrs.)</th>
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<td>GEL 201</td>
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<td>GEL 202</td>
<td>Structural Geology &amp; Tectonics</td>
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<td>Lab.-I Stratigraphy, Structural Geology, Palaeontology &amp; Field Training*</td>
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Total credits in the semester: 18

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<td>Oceanography and Palaeoclimatology</td>
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<td>GEL B04</td>
<td>Lab.-I Gemology, Isotope geology, Palaeoclimatology &amp; Field Training</td>
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Crustal Evolution & Phanerozoic Stratigraphy

Unit- I


Unit -II

Palaeozoic & Mesozoic stratigraphy of India: nomenclature, classification, distribution, structures, succession, sedimentary history, fauna, flora, age, igneous intrusion, palaeogeography, palaeoclimate and regional correlation.

Unit -III


Unit - IV

Unit- I
Earth as a dynamic system. Internal constitution of the Earth; heterogeneity of the Earth; seismic, gravity and magnetic characteristics. Continental drift, seafloor spreading. Plate tectonics, Paleomagnetism and its application.

Unit- II
Seismicity and seismic belts of the Earth. Continental shield areas and mountain chains. Features associated with oceanic crust, mid-oceanic ridges, gravity and magnetic anomalies at mid oceanic ridges, Deep sea trenches, Island arcs and Volcanic arcs.

Unit- III

Unit-IV
Unit - I


Unit - II

Palaeoecology: 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.

Unit - III

Paleobiogeographic provinces. Collection, preparation and preservation of fossils. Application of the following groups of fossils in stratigraphy and stratigraphic correlation/ reconstruction of palaeoenvironment: Foraminifers, Radiolarian, Serpulids, Conodonts and Ostracodes

Unit - IV

Ichnology: definition, classification, description of common Ichnogenera, their application in the reconstruction of depositional environment, sequence-stratigraphy, stratigraphic correlation.
M. Sc. GEOLOGY SECOND SEMESTER

Practical

Duration: 4 hours

Max. Marks 100

Structural Geology:

1. Solving structural problems by stereographic and orthographic projections.
2. Identification of structural elements and their chronology in hand specimen.
3. Structural analysis with stereo net: S-pole and beta-pole diagrams; Fold axis and axial plane; Contour diagrams; Methodology and interpretation of patterns.
4. Interpretation of geological maps and drawing of cross sections.

25 Marks

Palaeontology:

Labeled sketches, classification, morphological description, and age/horizon and Locality of available macro- and micro-fossil specimens. Study of index fossils in their chronological order.

25 Marks

Phanerozoic Stratigraphy:

Identification, description and geochronology of Indian phanerozoic stratigraphic rocks. Phanerozoic Stratigraphic maps of India. Phanerozoic Palaeogeographic maps of India. Graphical representation of stratigraphic sections (Litholog)

10 Marks

Field Training

Mini-Project

Record

15 Marks

10 Marks

15 Marks

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Unit- I

Elements: atomic structure, formation, abundances, distribution in Earth and Solar System

Unit II

Radiogenic Isotopes: Radioactivity, Range of Isotopic Systems (Rb/Sr, Sm/Nd, U-Pb, 40Ar/39Ar), Applications to Geology (to trace source and reconstruct evolution), 14C dating.

Stable Isotopes: Fractionation, Range of Isotopic Systems (O, H, C), Application

Unit- III

Trace Elements: Definition, Types, Partition Coefficient and application of trace elements in petrogenesis and tectonic setting

Unit-IV

Applications: Sedimentary Rocks (Weathering, Diagenesis), Igneous Rocks (Partial Melting, Fractional Crystallization), Metamorphic Rocks (Metamorphic Reactions, P-T-t path)
Unit-I


Unit-II

Milankovitch and Monsoons. Milankovitch and Glaciation. Ice Core Records of Atmospheric Composition. Cenozoic Cooling and Glaciations

Unit-III

Last Glacial Maximum: Ice Sheets, Sea Level, Dating, Ocean Circulation. Reconstruction of paleoclimate based on rocks and fossils

Unit-IV

Rapid Climate Change – Records from Ice Cores and Land; Oceanic Records and Mechanisms. Holocene Climate. Climate change during the last millennium. A paleoclimate perspective on global warming
Gemology and Dimension Stones

Unit-I


Unit-II


Unit-III

Dimensional and decorative stones: Definition, Engineering properties of dimensional and decorative stones. Rock hardness/Polishing hardness, water absorption, texture, structure and color.

Unit-IV

Dimension Stone Mining; methods, blasting, diamond wire cutting, wedging and splitting, thermal cutting, polishing. Export potential of Dimension Stone.
M. Sc. GEOLOGY SECOND SEMESTER

Practical

Duration: 4 hours

Max. Marks: 100

Trace element & Isotope Data Interpretation

20 marks

Trace element based tectonic discrimination plots. Rb-Sr, Sm-Nd, Isochron diagrams, U-Pb Concordia plots. Age determination. Use of C, O and H isotopes in palaeoclimate reconstruction

Gemology and Dimension Stones

20 marks


Palaeoclimatic

Identification of fossils (flora and fauna), rocks and fossils for palaeoclimatic interpretation

20 marks

Field Training

15 Marks

Project in consultation with supervisor to be nominated among the faculty members on mutually agreed field work based topic. The candidate has to submit project report in form of a dissertation for evaluation and award of marks.

10 Marks

15 Marks

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<td>GEL 303</td>
<td>Sedimentology &amp; Sedimentary Petrology</td>
<td>CCC</td>
<td>4</td>
</tr>
<tr>
<td>4.</td>
<td>GEL 311</td>
<td>Lab.-I. Igneous and Sedimentary Petrology &amp; Field Training*</td>
<td>CCC</td>
<td>6</td>
</tr>
</tbody>
</table>

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### Electives Subjects

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Course Code</th>
<th>Electives Subjects</th>
<th>Course Category</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>GEL C01</td>
<td>Desert Geology</td>
<td>ECC</td>
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<tr>
<td>2.</td>
<td>GEL C02</td>
<td>Coal and Petroleum Geology</td>
<td>ECC</td>
<td>4</td>
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<tr>
<td>3.</td>
<td>GEL C03</td>
<td>Geotechnical Engineering</td>
<td>ECC</td>
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<tr>
<td>4.</td>
<td>GEL C04</td>
<td>Lab.-I Coal and Petroleum Geology &amp; Desert Geology</td>
<td>ECC</td>
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</table>
### Course Structure

#### Semester 3

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Subject Code</th>
<th>Course Title</th>
<th>Course Category</th>
<th>Credit</th>
<th>Contact hours per week</th>
<th>EoSE duration (Hrs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Gel301</td>
<td>Mineral Exploration &amp; Mining Geology</td>
<td>CCC</td>
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<tr>
<td>2.</td>
<td>Gel302</td>
<td>Igneous Petrology</td>
<td>CCC</td>
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<td>3-0</td>
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<tr>
<td>3.</td>
<td>Gel303</td>
<td>Sedimentology &amp; Sedimentary Petrology</td>
<td>CCC</td>
<td>4</td>
<td>4-0-0</td>
<td>3-0</td>
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<tr>
<td>4.</td>
<td>Gel311</td>
<td>Lab.-I. Igneous and Sedimentary Petrology &amp; Field Training*</td>
<td>CCC</td>
<td>6</td>
<td>0-0-8</td>
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</table>

**Total credits in the semester**: 18

*Field Training is Compulsory, Student not taking part in the field training shall not be allowed to appear in the semester examination*
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<tr>
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<td>1.</td>
<td>GEL C01</td>
<td>Desert Geology</td>
<td>ECC</td>
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<td>4-0-0</td>
<td>3-0</td>
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<tr>
<td>2.</td>
<td>GEL C02</td>
<td>Coal and Petroleum Geology</td>
<td>ECC</td>
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<td>3-0</td>
</tr>
<tr>
<td>3.</td>
<td>GEL C03</td>
<td>Geotechnical Engineering</td>
<td>ECC</td>
<td>4</td>
<td>4-0-0</td>
<td>3-0</td>
</tr>
<tr>
<td>4.</td>
<td>GEL C04</td>
<td>Lab.–I Coal and Petroleum Geology &amp; Desert Geology</td>
<td>ECC</td>
<td>6</td>
<td>0-0-8</td>
<td>0-4</td>
</tr>
</tbody>
</table>

Total credits in the semester: 18

Total Credit in Semester I: 18 credit (CCC) + 18 Credit (ECC) = 36 Credits
Unit I

Guides for locating mineral & ore deposits: structural, lithological, stratigraphic and physiographic guides. Surface prospecting methods: pitting and trenching sampling: various methods of sampling.

UNIT - II

Outline of geophysical prospecting; gravity, seismic, electrical and magnetic prospecting for mineral deposits & also oil and ground water. Brief outline of geochemical prospecting.

UNIT - III

Drilling, different types of drilling, use of diamond drilling in exploration; core-logging and assaying; sampling: various methods of sampling; explosives: types, storage and precautions in handling of explosives, blasting; various patterns of blast holes and methods of their charging and blasting.

UNIT - IV

Elements of mining: mining methods; various types of surface and underground mining methods; factors involved in selection of open cast and underground mining methods; salient features of bench-mining, sub-level stopping; shrinkage stopping, Cut & fill method, coal mining methods: room and pillar method, long wall method.
Igneous Petrology

Unit - I


Unit - II

Mineralogical and chemical classification of igneous rocks including IUGS systematics. Concept of tectonic classification of granite and basalt. Phase rule, crystallization process in silicate melts in light of experimental studies for following systems: Diopside – Anorthite, Albite – Anorthite; Albite – Orthoclase, Forsteite – Silica; Crystallization of Ternary system: Diopside-Forsterite-Silica.

Unit - III

Major, trace, REE and isotopic compositions of igneous rocks and their implication in petrogenesis and tectonic setting. Mode of occurrence, nomenclature, classification and petrogenesis of the following rocks: Alkaline rocks, Ophiolites, Lamprophyres, Ultramafics and Carbonatites.

Unit - IV

Mode of occurrence, nomenclature, classification and petrogenesis of acid, basic and intermediate rock associations and pegmatites.
Unit - I

Unit - II
Genesis & classification of sedimentary rocks: Siliciclastic rocks - conglomerate, breccia, sandstone, siltstone, claystone and shale. Carbonate rocks - limestone, dolomite, marl, evaporite, phosphorite, chert, iron and manganese rich sediments.

Unit - III
Structures and textures in sedimentary rocks and their significance. Application of trace elements, rare earth elements and stable isotope geochemistry to sedimentological investigation.

Unit - IV
Tectonics and sedimentation: classification of sedimentary basins, basin analysis; stacking pattern, sediment composition, paleocurrent analysis. Sedimentary basins of India.
M. Sc. GEOLOGY THIRD SEMESTER

Practical

Duration: 4 hours

Igneous Petrology

Identification and description of important igneous rocks in hand specimen. Petrographic studies of important igneous rocks. Preparation and interpretation of variation diagrams in relation to petrogenesis. Calculation of CIPW norms.

30 Marks:

Sedimentary Petrology:

Identification and description of important sedimentary rocks in hand specimen. Petrographic studies of important sedimentary rocks. Graphic representation of data and its interpretation.

30 Marks

Field work

15 Marks

Viva-Voce

10 Marks

Record

15 Marks

Max. Marks 100

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR
Unit- I

Unit- II

Unit- III

Unit- IV
Engineering Geology and Geohazards. Traditional knowledge in dryland management and combating desertification. Ground water resources. Wind and Sun as energy resource in the deserts.
Coal and Petroleum Geology

Unit-I


Unit-II

Geology and coal petrography of different coalfields of India. Uses of coal for various industries e.g. carbonization, liquefaction, power generation, gasification and coal-bed methane production.

Unit-III

Petroleum: its different states of natural occurrence, chemical composition and physical properties of crudes in nature. Origin of petroleum, Maturation of kerogen; Biogenic and Thermal effect. Reservoir rocks: general attributes and petrophysical properties. Classification of reservoir rocks - fragmental reservoir rocks and chemical reservoir rocks. Migration of oil and gas

Unit-IV

Geotechnical Engineering

Unit - I
Geo-technical engineering as a field science related to construction. Scope of geotechnical engineering. Ground investigations – Introduction, Types of ground investigation, Geological mapping for ground investigation.

Field investigations - Introduction, Excavations and boreholes - Shallow trial pits, Deep trial pits and shafts, Headings (adits), Hand auger boring, Light cable percussion drilling, Mechanical augers, Wash boring and other methods, Backfilling excavations and boreholes.

Unit - II
Sampling. Frequency of sampling. Sampling the ground - General principles, Sample quality. Disturbed samples from boring tools or from excavating equipments, Types of samplers - Open-tube samples and samplers, Stationary piston sampler, Continuous soil sampling, Sand samplers, Rotary core samplers, Window sampler, Block samples. Handling and labelling of samples.

Field and lab tests Field tests. Geophysical surveying (Electrical resistivity, Gravity, Magnetic, Seismic methods, Laboratory tests on samples - Tests on soil - Classification tests - Moisture content/ water content determination, Liquid and plastic limits (Atterberg Limits), Particle size distribution (grading) by sieving. Soil strength tests

Unit - III

Rock Mechanics - Saturation moisture content (alteration index), Bulk density, Moisture content, Petrographic analysis, Hardness and abrasiveness, Carbonate test, Swelling test. Rock strength tests - Point load test, Uniaxial Compression, Direct tension test, Indirect tensile strength test (Brazil test).

Unit - IV

Logging - Description of soils and rocks. Description of soils - Mass characteristics of soils. Material characteristics of soils – Colour, Particle shape, grading and composition. Description and classification of rocks - General description - Strength of rock material, Structure, Colour, Texture, Grain size, State of weathering, Rock name. Total core recovery (TCR), solid core recovery (SCR), Rock Quality Designation (RQD).

Dy. Registrar (Academic)
University of Rajasthan
JAIPUR
M. Sc. GEOLOGY THIRD SEMESTER

Practical

GEL CO4

Max. Marks 100

Duration: 4 hours

Coal and Petroleum Geology

40 Marks

Megascopic identification of different varieties of coal. Interpretation of geologic structures from surface geological maps and bore hole data; reconstruction of structural developments through different time planes. Panel and Fence diagram. Interpretation of sub-surface facies relationships from borehole data.

Preparation of structure contour and isopach maps of reservoir facies and drawing oil/water contact from bore hole data. Problems on porosity and permeability Problems on deviation drilling Calculation of oil reserves in defined structure.

Desert Geology

20 Marks

Identification and description of desert related geomorphological features

Project work

15 Marks

Project in consultation with supervisor to be nominated among the faculty members on mutually agreed topic. The candidate has to submit project report in form of a dissertation for evaluation and award of marks.

Viva-Voce

10 Marks

15 Marks
### Course structure

#### Semester 4

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Subject Code</th>
<th>Course title</th>
<th>Course Category</th>
<th>Credit</th>
<th>Contact hours per week</th>
<th>EoSE duration (Hrs.)</th>
</tr>
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<tbody>
<tr>
<td>1.</td>
<td>Gel401</td>
<td>Metamorphic Petrology</td>
<td>CCC</td>
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<td>2.</td>
<td>Gel402</td>
<td>Resource Geology</td>
<td>CCC</td>
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<td>4-0-0</td>
<td>3-0</td>
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<tr>
<td>3.</td>
<td>Gel403</td>
<td>Environmental Geology &amp; Hydrogeology</td>
<td>CCC</td>
<td>4</td>
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<td>3-0</td>
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<tr>
<td>4.</td>
<td>Gel411</td>
<td>Lab.-I Metamorphic Petrology, Resource Geology, Environmental Geology &amp; Field Training*</td>
<td>CCC</td>
<td>6</td>
<td>0-0-8</td>
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  (Academic)
  University of Rajasthan
  JAIPUR
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>GEL D01</td>
<td>Disaster Management</td>
<td>ECC</td>
<td>4</td>
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<td>2.</td>
<td>GEL D02</td>
<td>Geoinformatics</td>
<td>ECC</td>
<td>4</td>
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<td>3-0</td>
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<tr>
<td>3.</td>
<td>GEL D03</td>
<td>Ground water exploration &amp; Management</td>
<td>ECC</td>
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<tr>
<td>4.</td>
<td>GEL D04</td>
<td>Lab.-I Groundwater exploration, Geoinformatics and Disaster Management</td>
<td>ECC</td>
<td>6</td>
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</tbody>
</table>

Total credits in the semester: 18

Total Credit in Semester I: 18 credit (CCC) + 18 Credit (ECC) = 36 Credits
### Semester 4

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Course Code</th>
<th>Core Subjects</th>
<th>Course Category</th>
<th>Credit</th>
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<tbody>
<tr>
<td>1.</td>
<td>GEL 401</td>
<td>Metamorphic Petrology</td>
<td>CCC</td>
<td>4</td>
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<tr>
<td>2.</td>
<td>GEL 402</td>
<td>Resource Geology</td>
<td>CCC</td>
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<tr>
<td>3.</td>
<td>GEL 403</td>
<td>Environmental Geology &amp; Hydrogeology</td>
<td>CCC</td>
<td>4</td>
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<tr>
<td>4.</td>
<td>GEL 411</td>
<td>Lab.-I Metamorphic Petrology, Resource Geology, Environmental Geology &amp; Field Training*</td>
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<tbody>
<tr>
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<td>GEL D01</td>
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<td>6</td>
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Unit - I
Agents and kinds of metamorphism; metamorphic zones; grades; metamorphic facies; Fabric of metamorphic rocks formed under regional, dynamic and thermal metamorphisms; Classification of regional metamorphism based on P/T ratio. Thermodynamics: principle and application in kinetics of metamorphic reactions

Unit - II
Mineralogical phase rule. Diagrammatic representation of mineral paragenesis in ACK, AKF and AFM diagrams. Study of metamorphic facies: zeolite facies; pumpellyite-prehnite facies; glucophane schist facies; green schist facies; amphibolite facies; granulite facies, eclogite facies; albite-epidote hornfels facies; hornblende-hornfels facies; pyroxene-hornfels facies; sanidinite facies.

Unit - III
Principles of metasomatism and metamorphic differentiation; petrogenetic grids; pressure, temperature, time paths; mineralogical and textural changes accompanying progressive regional metamorphism of mafic, ultramafic, pelitic and carbonate rocks.

Unit - IV
Anatexis and formation of migmatites and origin of granitic magma; petrographic and petrogenetic studies of charnockite, migmatite and amphibolite; metamorphism in relation to magma and orogeny; metamorphism in relation to plate tectonics.
Unit-I
Plate tectonics and ore genesis. Ore bearing fluids, movement of ore bearing fluids, deposition of ores, sulphur and chloride complexes, deposition of Fe-O, Cu-S, Cu-Fe- Systems, Structures and textures of ores, wall rock alteration, controls of mineralization, classification of ore deposits, geothermometry and isotope studies.

Unit-II
Deposits related to mafic igneous rocks, oceanic crust and intermediate to felsic intrusions. Deposits related to sub-aerial volcanism and submarine volcanism. Deposits related to chemical sedimentation, clastic sedimentation, weathering, metamorphism and solution remobilization.

Unit-III
Study of the following metallic deposits in India with reference to their geographic and geologic distribution mode of occurrence and origin: iron, manganese, aluminum, chromium, gold, copper, lead, zinc and atomic minerals.

Unit-IV
Study of the following minerals in India with reference to their geographic and geologic distribution, mode of occurrence origin and uses: fertilizer minerals, refractory minerals, glass and ceramic minerals, abrasives, gemstones, cement, building stones, energy & fuel minerals: Coal and petroleum deposits: their distribution, classification, origin and potentialities; Important coal and petroleum fields of India.
Environmental Geology & Hydrogeology  

Unit - I  
Environmental Geology: definition and concept; green house effect, depletion of ozone layer, acid rain; global warming and climate change, mitigation and adaptation. Environmental impact of urbanization; air and noise pollution: causes, impact and remedial strategies.

Unit - II  
Environmental impact of mining activities; concept of eco-friendly mining; laws governing protection of environment and control of pollution; environmental impact assessment (EIA); Environmental Management Plan (EMP)

Unit - III  
Ground water: Genetic types, hydrological cycle. Occurrence and distribution of ground water. Aquifer and its hydrological properties. Water table, water table contour maps; hydrological properties of rocks - specific yield, specific retention, porosity, hydraulic conductivity, transmissivity, storage coefficient.

Unit - IV  
M. Sc. GEOLOGY FOURTH SEMESTER

Practical

GEL 411

Duration: 4 hours

Max. Marks 100

Metamorphic Petrology: 20 Marks

Identification and description of important metamorphic rocks in hand specimen. Petrographic studies of important metamorphic rocks. Graphic construction of ACF, AKF and AFM diagrams.

Resource Geology: 20 Marks

Identification and description of important fuel minerals in hand specimen. Distribution of fuel deposits (oil, coal & radioactive minerals) in India.

Environmental Geology & hydrogeology 20 Marks

Analysis of different parameters of air, water and noise. Interpretation of air, water and noise data. Preparation of iso-concentration maps of water quality parameters.

Calculation and exercises on groundwater quality, exploration, yield, recharge, water table fluctuation etc.

Field work 15 Marks

Viva-Voce 10 Marks

Record 15 Marks
Disaster Management

Unit-I
Objectives and scope-Natural and non natural disasters. Land slides; causes of landslides-hazards pertaining to land slides and management planning for landslide disaster. Soil erosion-process of formation of soil, soil horizon, soil properties, soil classification, causes of soil erosion, effects of soil erosion, strategies to prevent soil erosion. Floods; causes, effects and disaster management techniques.

Unit- II
Earthquakes; causative factors, seismic waves, distribution of seismicity in India, hazards related to earthquake, earthquake disaster management planning. Volcanoes; causes, effects and hazard management methods. Tsunamis- origin, significance and prediction

Unit- III
Environmental problems associated with human activities; impact of sand mining on environment. Impact of mining on environment. Problems inflicted by granite mining. Coastal erosion-effects and remedial measures.

Unit- IV
Unit I


Unit II


Unit III


Unit IV

Data entry into GIS. GIS vector data. GIS raster data. GIS layers. Data, extraction from GIS by simple querying. Basic map generation. Introduction to GIS packages: Free GIS – GRASS and gvSIG. Commercial GIS – ArcGIS. Case studies in ground water table, geological mapping, contour map either water level contour map or surface contour map. Applications of GIS in water quality, land use and soil pollution etc. Creation of buffer.
Ground water exploration and Management

Unit-I

Origin - meteoric, juvenile and connate waters. Hydrological cycle, occurrence; ground water occurrences in igneous, sedimentary and metamorphic rocks - vertical distribution of ground water, movement; classification and types of aquifers, definition of porosity, permeability, specific yield, specific retention, storage and transmissibility.

Unit-II

Groundwater detection; surface methods - geomorphological, structural and biological evidences. Surface geophysical methods; principles, field procedures, electrode arrangements, instruments and interpretations involved in electrical resistivity method of ground water exploration. Brief account of role of remote sensing in ground water targeting.

Unit-III

Well design and well development; brief introduction about dug wells, tube wells, jetted wells, infiltration galleries and collector wells, well screening and artificial packing. Well development through surging and acidizing. Methodology and need for pump test.

Unit-IV

Water quality; Quality of water in various rock types, water quality parameters and their standards proposed by WHO and BIS. Physical parameters of water quality. Chemical parameters and determining methods. Diseases and virological aspects of ground water and remedial measures. Ground water management; meaning of water shed and river basins. Ground water provinces of India. Artificial recharge and ground water harvesting techniques.
M. Sc. GEOLOGY FOURTH SEMESTER

Practical

GEL DO4

Max. Marks 100

Ground water exploration & Management 30 Marks

1. Preparation and interpretation of water table contour maps and depth to water level contour maps.
2. Study, preparation and analysis of hydrographs for differing groundwater conditions.
3. Water potential zones of India (map study) including saline water zones.
4. Graphical representation of chemical quality data and water classification (C-S and Trilinear diagrams).

Disaster Management 30 Marks

Seismic maps of World, India and Rajasthan. Exercises on slope failure and landslides.

Field work 15 Marks

Viva-Voce 10 Marks

Record 15 Marks