



# University of Rajasthan Jaipur

## SYLLABUS

### M.Sc. GEOLOGY

(Semester Scheme)

I & II Semester Examination      2022-23

III & IV Semester Examination      2023-24

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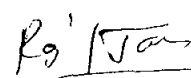
M.Sc. Geology  
Course structure

**Semester -1**

S. No.	Course code	Core Subjects	Course Category	Credit
1.	GEL101	Mineralogy, Crystallography & Geochemistry	CCC	4
2.	GEL102	Invertebrate & Vertebrate Paleontology & palaeobotany	CCC	4
3.	GEL103	Principles of stratigraphy & Precambrian stratigraphy	CCC	4
4.	Gel 104	Lab-I Mineralogy, Crystallography, Geochemistry, Palaeontology, Stratigraphy & Field Training	CCC	4

S. No.		Elective Subjects	Course category	Credit
1.	GEL A01	Sequence Stratigraphy	ECC	4
2.	GEL A02	Palaeoecology	ECC	4
3.	GEL A03	Geomorphology & Remote Sensing	ECC	4
4.	GEL A04	Lab-I Remote Sensing, Palaeoecology & Geomorphology	ECC	6

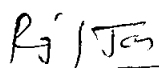
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**Semester-2**

S. No.		Elective Subjects	Course category	Credit
1.	GEL 201	Crustal Evolution & Phanerozoic Stratigraphy	CCC	4
2.	GEL 202	Structural Geology & Tectonics	CCC	4
3.	GEL 203	Applied Palaeontology & Micropalaeontology	CCC	4
4.	GEL 211	Lab-I Stratigraphy, Structural Geology, Palaeontology & Field Training	CCC	6

S. No.		Elective Subjects	Course category	Credit
1.	GELB01	Isotope Geology	ECC	4
2.	GELB02	Oceanography and Palaeoclimate	ECC	4
3.	GELB03	Gemology & Dimension stones	ECC	4
4.	GELB04	Lab-I Gemology, Isotope Geology & Palaeoclimate	ECC	6

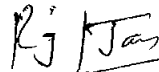
  
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5

## Semester -3

S. No.		Elective Subjects	Course category	Credit
1.	GEL 301	Mineral exploration & Mining Geology	CCC	4
2.	GEL 302	Igneous Petrology	CCC	4
3.	GEL 303	Sedimentary Petrology	CCC	4
4.	GEL 311	Lab-I Igneous and sedimentary Petrology & Field Training	CCC	6

S. No.		Elective Subjects	Course category	Credit
1.	GEL C01	Desert Geology	ECC	4
2.	GEL C02	Coal and Petroleum Geology	ECC	4
3.	GEL C03	Geotechnical Engineering	ECC	4
4.	GEL C04	Lab-I Coal and Petroleum Geology & Desert Geology	ECC	6

  
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Semester -4

S. No.		Elective Subjects	Course category	Credit
1.	GEL 401	Metamorphic Petrology	CCC	4
2.	GEL 402	Resource Geology	CCC	4
3.	GEL 403	Environmental Geology & Hydrogeology	CCC	4
4.	GEL 411	Lab-I Metamorphic Petrology, Resource Geology, Environmental Geology & Field Training	CCC	6

S. No.		Elective Subjects	Course category	Credit
1.	GEL D01	Disaster Management	ECC	4
2.	GEL D02	Geoinformatics	ECC	4
3.	GEL D03	Ground water exploration & Management	ECC	4
4.	GEL D04	Lab-I Groundwater exploration, Geoinformatics and Disaster Management	ECC	6

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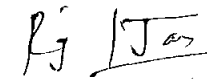
## Course Structure

### Semester -1

S. No.	Subject code	Elective Subjects	Course category	Credit	Contact hours per week	EoSE duration (Hrs.)
					L-T-P	Thy-P
1.	GEL 201	Mineralogy, Crystallography & Geochemistry	CCC	4	4-0-0	3-0
2.	GEL 202	Invertebrate & Vertebrate Paleontology & palaeobotany	CCC	4	4-0-0	3-0
3.	GEL 203	Principles of stratigraphy & Precambrian stratigraphy	CCC	4	4-0-0	3-0
4.	GEL 211	Lab-I Mineralogy, Crystallography, Geochemistry, Palaeontology, Stratigraphy & Field Training	CCC	6	0-0-8	3-0
Total credits in the semester				18		

### Semester -2 Elective


S. No.	Subject code	Course title	Course category	Credit	Contact hours per week	EoSE duration (Hrs.)
					L-T-P	Thy-P
1.	GEL B01	Sequence Stratigraphy	ECC	4	4-0-0	3-0
2.	GEL B02	Palaeoecology	ECC	4	4-0-0	3-0
3.	GEL B03	Geomorphology & Remote Sensing	ECC	4	4-0-0	3-0
4.	GEL B04	Lab-I Remote Sensing, Palaeoecology & Geomorphology	ECC	6	0-0-8	3-0
Total credits in the semester				18		

  
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## Semester -2

S. No.	Course code	Core Subjects	Course category	Credit
1.	GEL 101	Mineralogy, Crystallography & Geochemistry	CCC	4
2.	GEL 102	Invertebrate & Vertebrate Paleontology & palaeobotany	CCC	4
3.	GEL 103	Principles of stratigraphy & Precambrian stratigraphy	CCC	4
4.	GEL 111	Lab-I Mineralogy, Crystallography, Geochemistry, Palaeontology, Stratigraphy & Field Training	CCC	6

S. No.	Course code	Electives Subjects	Course category	Credit
1.	GEL A01	Sequence Stratigraphy	ECC	4
2.	GEL A02	Palaeoecology	ECC	4
3.	GEL A03	Geomorphology & Remote Sensing	ECC	4
4.	GEL A04	Lab-I Remote Sensing, Palaeoecology & Geomorphology	ECC	6

  
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**Unit-I**

Working principle of petrological microscope, optical properties of minerals, Optical accessories and their use, Uniaxial and biaxial minerals, Interference figures.

**Unit-II**

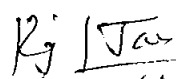
Chemical composition, crystal structure, P-T stability, physical and optical properties and mode of occurrence of pyroxene, amphibole, mica and feldspar group of minerals.

**Unit-III**

Symmetry in crystal; 32 point groups (Symmetry classes). Stereographic projection, introduction to X-Ray and its application in study of minerals, Bragg's Law, Rotation Method and Powder Method.

**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.

  
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**Unit-I**

Geological history and application of Lamellibranchs (with functional morphology), Gastropods, Nautiloids, Ammonoides, Belemnites, Barchiopods (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, Bryozones, Echinoids (with functional morphology), Crinoides.

**Unit-III**

Palaeobotany: classification of Kingdom Plantae, Gondwana Flora: systematic study of important Gondwana Plants, Application bearing on palaeoclimate. Application of the following groups of fossils in stratigraphy/ stratigraphic correlation/ reconstruction of palaeoenvironment: Algae (Calcareous/ Siliceous Coccolithophore, Stromatolites, Dinoflagellates, Halimeda, Diatoms, Pollen grains and spores.)

**Unit-IV**

Outline of classification of vertebrates, significance of vertebrate palaeontology, sequence of vertebrate through geological ages. Evolutionary history of man, Elephant and horse. Classification, significance and extinction of Dinosaurs.

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**Unit-I**

Code of stratigraphic nomenclature, Geochronology, Stratigraphic classification: lithostratigraphy, biostratigraphy and chronostratigraphy and their units. Sequence stratigraphy: concept and application, Magnetostratigraphy, Climatostratigraphy, Seismic Stratigraphy, Event Stratigraphy, Graphic representation of stratigraphic data.

**Unit-II**

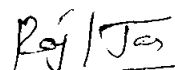
Distribution, stratigraphic correlation, succession, geochronology and economic importance of Archean and Paleoproterozoic rocks of India; Dharwar Province, Eastern Ghat Province, Central Indian Province and Singhbhum-Orissa Province.

**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 Malani Igneous Suite.

  
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M.Sc. GEOLOGY FIRST SEMESTER

Practical

GEL-111

Duration: 4 hours

Max. Marks 100

**Mineralogy & Crystallography:**

**30 Marks**

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.

**Palaeontology:**

**20 Marks**

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

**Precambrian Stratigraphy:**

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

**Viva-Voce**

**10 Marks**

**Field Training**

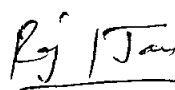
**15 Marks**

**Record**

**15 Marks**

**Compulsory Field Training Program:** Geological Mapping Training- 10 days duration.

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## Sequence Stratigraphy

GEL-A01

### Unit-I

Introduction- Sequence stratigraphy-An Overview, Approach. Methods of Sequer Stratigraphic Analysis-Facies analysis: Outcrops, Well Logs, Seismic Data. Age determination Techniques.

### Unit-II

Accommodation and shoreline Shifts. Sequence stratigraphic Surface-Transgressive surface Maximum Flooding surface. Systems Tracts-Highstand Systems Tract, Falling-stage systems Tract, Lowstand Systems Tracts, Transgressive Tract, Regressive Systems Tract.

### Unit-III

Sequence Models-types of stratigraphic sequences in Fluvial Systems, sequences Coastal to Shallow-Water clastic Systems, sequences in Deep-Water Clastic Systems, Sequences in Carbonate Systems.

### Unit-IV

Hierarchy of Sequences and Sequence Boundaries-Hierarchy System Based on Cycle Duration (Boundary Frequency) Systems Based on the Magnitude of Base-Level Changes.

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**Palaeoecology**

**GEL-A02**

**Unit-I**

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

**Unit-II**

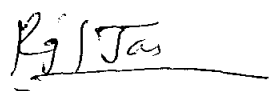
Requisites of fossilization, Principle of Uniformitarianism. Subdivision of aquatic environment Environmental parameters.

**Unit-III**

Autoecology: mode of life, functional/constructional morphology, adaptation of bivalve with all photosymbiosis, symbiosis with chemoautotrophic bacteria. Population dynamics, mortal rate.

**Unit-IV**

Trace fossils: introduction, classification, morphology, their significance in Palaeocological interpretation. Various approaches to reconstruct the palaeoenvironment.

  
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## Geomorphology & Remote Sensing

GEL-A03

### 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. Tectonics subdivision of India.

### Unit-II

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.

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M.Sc. GEOLOGY FIRST SEMESTER

Practical

GEL-A04

Duration: 4 hours

Max. Marks 100

**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 cycle in the given lith-log Draw fence diagram based on different lith-logs of a sedimentary basin.

**palaeoecology**

**25 Marks**

palaeoecological analysis: Quantitative and Taphonomic analysis: species diversity, tropic 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 Exercise on Slope analysis.

**Remote Sensing**

**25 Marks**

Scale and hight of aerial photographs. Interpretation of aerial photographs. Visual interpretation of satellite imageries. Image analysis exercise. Applications using GIS software.

**Viva-Voce**

**10 Marks**

**Record**

**15 Marks**

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## Course Structure

### Semester -2

S. No.	Subject code	Elective Subjects	Course category	Credit	Contact hours per week	EoSE duration (Hrs.)
					L-T-P	Thy-P
1.	GEL 201	Crustal Evolution & Phanerozoic Stratigraphy	CCC	4	4-0-0	3-0
2.	GEL 202	Structural Geology & Tectonics	CCC	4	4-0-0	3-0
3.	GEL 203	Applied Palaeontology & Micropalaeontology	CCC	4	4-0-0	3-0
4.	GEL 211	Lab-I Stratigraphy, Structural Geology Palaeontology & Field Training	CCC	6	0-0-8	3-0
Total credits in the semester				18		

### Semester -2 Elective

S. No.	Subject code	Course title	Course category	Credit	Contact hours per week	EoSE duration (Hrs.)
					L-T-P	Thy-P
1.	GEL B01	Isotope Geology	ECC	4	4-0-0	3-0
2.	GEL B02	Oceanography and Palaeoclimatology	ECC	4	4-0-0	3-0
3.	GEL B03	Geomology & Dimension stones	ECC	4	4-0-0	3-0
4.	GEL B04	Lab-I Gemology, Isotope Geology, Palaeoclimatology & Field Training	ECC	6	0-0-8	3-0
Total credits in the semester				18		



## Semester -2

S. No.	Course code	Core Subjects	Course category	Credit
1.	GEL 201	Crustal Evolution & Phanerozoic Stratigraphy	CCC	4
2.	GEL 202	Structural Geology & Tectonics	CCC	4
3.	GEL 203	Applied Palaeontology & Micropalaeontology	CCC	4
4.	GEL 211	Lab-I Stratigraphy, Structural Geology, Palaeontology & Field Training	CCC	6

S. No.	Course code	Electives Subjects	Course category	Credit
1.	GEL B01	Isotope Geology	ECC	4
2.	GEL B02	Oceanography and Palaeoclimatology	ECC	4
3.	GEL B03	Gemology & Dimension stones	ECC	4
4.	GEL B04	Lab-I Gemology, Isotope Geology & Palaeoclimatology	ECC	6

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## **Crustal Evolution & Phanerozoic Stratigraphy**

**GEL-201**

### **Unit-I**

Early history of the earth, nature of primitive crust and evolution of early crust. Evolution of Granite-Greestone and Granulite belts. Precambrian Chronostratigraphy and their units. Outline of tectonics subdivision and Precambrian provinces of India.

### **Unit-II**

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

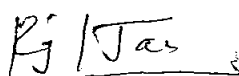
### **Unit-III**

Gondwana Supergroup of India: nomenclature, classification, distribution, structures, succession, sedimentary history, fauna, flora, age. Deccan traps; age, duration of volcanism, infra & Inter-trappeans sedimentary formations and their fossils. Precambrian-Cambrian, Permian-Triassic and Cretaceous-Tertiary (KT) boundaries.

### **Unit-IV**

Cenozoic stratigraphy of India: nomenclature, classification, distribution and regional correlation. Siwalik System; distribution, fossils and age.

Palaeozoic stratigraphy of Rajasthan: divisions and rock types.

  
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**Unit-I**

Earth as a dynamic system; Continental drift, sea floor spreading. The Earth's crust, mantle and core; Phase transitions and seismic discontinuities in the earth; seismic waves tectonic. Paleomagnetism and its application.

**Unit-II**

Plate tectonic and Tectonics setting; Features associated with plate boundaries; Deep sea trenches, Island arcs and volcanic arcs. Gravity and magnetic anomalies. Concept of subduction and orogeny. Major global organic events in the geological past and their correlation with Indian examples; Himalayan orogeny. Continental shield areas and mountain chains. Principles of geological mapping, projection diagrams.

**Unit-III**

Concept of stress and Strain; 2-D stress and strain analysis, Stress-strain relation; Behavior of rocks under stress: elastic, plastic, viscous and visco-elastic responses. Mohr diagrams and their use; Brittle-plastic transition and seismic behavior of the upper crust. Mechanics of rocks fracturing. Lamination: Types origin and deformation. Geometric analyses of joints.

**Unit-IV**

Folds; Geometry, classification, mechanism of folding; superimposed folds: Occurrence, recognition and geometric analyses. Cleavage; origin, mechanics and relationship with folding. Faults: Geometry, classification, mechanism of faulting. Shear zones, sense indicators, shear zone kinematics.

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**Unit-I**

Origin of life, theories, mechanism and evidence of evolution. Major events in the history of Paleozoic, Mesozoic and Cenozoic life. Evidences of life during Precambrian, Taxonomy: classification and species nomenclature. Migration, dispersion and extinction of plants.

**Unit-II**

Palaeoecology: a) fundamentals, b) palaeoenvironment: physical parameters and various approaches of reconstruction,) 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**

Icnology: definition, classification, description of common Ichnogenera, their application in the reconstruction of depositional environment, sequence stratigraphy, stratigraphic correlation.

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M.Sc. GEOLOGY FIRST SEMESTER

Practical

Gel-211

Duration: 4 hours

Max. Marks 100

**Structural Geology:**

**25 Marks**

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 Metaodology and Interpretation of patterns.
4. Interpretation of geological maps and drawing of cross sections.

Palaeontology :

25 Marks

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

Phanerozoic Stratigraphy:

10 Marks

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

Field Training

15 Marks

Viva –Voce

10 Marks

Record

15 Marks

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**Unit-I**

Nucleosynthesis. Stellar evolution and origin of elements. Distribution of elements in core, mantle, hydrosphere and atmosphere. Goldschmidt's classification of elements. Oddo-Harkn Law. Geochemical cycle. Meteorites-types and composition

**Unit-II**

Fractionation of elements in minerals/rocks. Nernst's partition coefficient (compatible and incompatible elements), Nernst-Berthelot partition coefficient and bulk partition coefficient; Fick's laws of diffusion and activity composition relation (Roult's and Henry's law); Application of trace elements in Petrology. Rare Earth Elements. Eh and pH diagrams and mineral stability.

**Unit-III**

Half-life and decay equation. Dating of minerals and rocks with potassium-argon, rubidium-strontium, uranium-lead and samarium-neodymium isotopes. Petrogenetic implications of samarium-neodymium and rubidium-strontium systems.

**Unit-IV**

Principles of equilibrium and Rayleigh fractionation. Stable isotope geochemistry of carbon, oxygen, hydrogen and sulphur and their applications in geology; U-Pb-Th mineral chemical dating.

**Practical:**

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.

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## **Oceanography and Palaeoclimatology**

**GEL-B02**

### **Unit-I**

Introduction and overview of Oceanography, Introduction to climate, Global climate pattern, Climate controlling factors, Global Energy Balance and Faint Young Sun, CO<sub>2</sub>-Weathering Climate regulation. Greenhouse Earth: Cretaceous Climate/ Late Paleocene-Eocene Thermal Maximum (PETM)

### **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-III**

Rapid Climate Change- Records from ice Cores and Land, Oceanic Records and Mechanism. Holocene Climate. Climate change during the last millennium. A paleoclimate on global warming.

  
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## **Gemmology & Dimension Stones GEL-B03**

### **Unit-I**

Gemology- Definition and scope of gemstones, Attributes of gemstones. Characteristics and classification. Value of gemstones, grading, cutting and polishing. Mineralogy of gemstones.

### **Unit-II**

Treatments for quality improvement applied to gemstones-Heat, Radiation, Waxing/oiling, Fracture filling. Synthetic gemstones. Physical, Chemical and optical properties of gemstones.

Gem cutting Instruments. Industrial applications of gemstones. Gem industrial centers in India and world. Gemstones of India distribution, geological setting and genesis.

### **Unit-III**

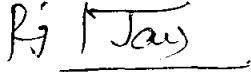
Dimensional and decorative stones: definition, engineering properties of dimensional and decorative stones including rock hardness/polishing hardness, water absorption, texture, and structure. IUGS concept of global heritage stone resources.

### **Unit-IV**

Geology and distribution of important dimensional stones occurrences of Rajasthan. Dimension stone mining; blasting, diamond wire cutting, wedging and splitting, thermal cutting, polishing. Export potential of dimensional stones of Rajasthan.

### **Practical:**

Identification of Gem stones: physical and optical properties. Determination of Refractive index, distinction between synthetic and natural gemstone. Distribution and occurrence of gemstones and dimension stone in India with special reference to Rajasthan. Gem cutting and polishing techniques.

  
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M.Sc. GEOLOGY SECOND SEMESTER

Practical

Gel-B04

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**

Identification of Gem minerals: physical and optical property.

Determination of Refractive Index, and distinction between natural and synthetic gemstone. Distribution and occurrence of Gemstone and Dimension Stone in India with special reference to Rajasthan. Gem cutting and polishing techniques.

**Palaeoclimate**

**20 Marks**

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

**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.

**Viva-Voce**

**10 Marks**

**Record**

**15 Marks**

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## Course Structure

### Semester -3

S. No.	Subject code	Course title	Course category	Credit	Contact hours per week	EoSE duration (Hrs.)
					L-T-P	Thy-P
1.	GEL 301	Mineral exploration & Mining Geology	CCC	4	4-0-0	3-0
2.	GEL 302	Igneous Petrology	CCC	4	4-0-0	3-0
3.	GEL 303	Sedimentology & Sedimentary Petrology	CCC	4	4-0-0	3-0
4.	GEL 311	Lab-I Igneous and Sedimentary Petrology & Field Training	CCC	6	0-0-8	3-0
Total credits in the semester				18		

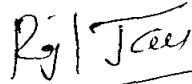
### Semester -3 Elective

S. No.	Subject code	Course title	Course category	Credit	Contact hours per week	EoSE duration (Hrs.)
					L-T-P	Thy-P
1.	GEL C01	Desert Geology	ECC	4	4-0-0	3-0
2.	GEL C02	Coal and Petroleum Geology	ECC	4	4-0-0	3-0
3.	GEL C03	Geotechnical Engineering	ECC	4	4-0-0	3-0
4.	GEL C04	Lab-I Coal and Petroleum Geology & Desert Geology	ECC	6	0-0-8	3-0
Total credits in the semester				18		

**Semester -3**

S. No.	Course code	Core Subjects	Course category	Credit
1.	GEL 301	Mineral exploration & Mining Geology	CCC	4
2.	GEL 302	Igneous Petrology	CCC	4
3.	GEL 303	Sedimentology & Sedimentary Petrology	CCC	4
4.	GEL 311	Lab-I Igneous and Sedimentary Petrology & Field Training	CCC	6

S. No.	Course code	Electives Subjects	Course category	Credit
1.	GEL C01	Desert Geology	ECC	4
2.	GEL C02	Coal and Petroleum Geology	ECC	4
3.	GEL C03	Geotechnical Engineering	ECC	4
4.	GEL C04	Lab-I Coal and Petroleum Geology & Desert Geology	ECC	6

  
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## Mineral exploration and Mining Geology

GEL-301

### Unit I

Introduction to prospecting. Pitting and trenching. Geological mapping. Structural, lithological, stratigraphic and physiographic ore guides. Major case histories of ore deposits of Rajasthan.

### Unit II

Introduction to geochemical prospecting: dispersion of elements. Soil, vegetation, and water surveys. Geophysical prospecting methods for mineral deposits, oil, and, groundwater.

### Unit III

Importance of drilling and its types: rotary, auger, and diamond. Sampling, core-logging and assaying. Explosives: types, handling, and precautions, blast-hole patterns, charging, and blasting.

### Unit IV

Elements of mining: surface mining, underground mining, mine machinery, mine ventilation and mine closure. Mineral processing: ore handling, comminution, concentration.

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**Unit-I**

Magma: origin, composition and constitution. Magma emplacement and its relation to plate tectonics. Magmatic evolution (differentiation, assimilation, mixing and mingling). Viscosity, temperature and pressure relationships in magmas. Nucleation and growth of minerals in magmatic rocks. Development of igneous textures and structures and their petrogenetic significance.

**Unit-II**

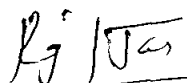
IUGS classification of plutonic and volcanic rocks. Concept of tectonic classification of granite and basalt. Mineralogical Phase Rule. Types of mantle melting (batch, fractional and dynamic); binary (albite-anorthite, forsterite-silica, albite-orthoclase and diopside-anorthite) and ternary (diopside-forsterite-silica, diopside-forsterite-anorthite and nepheline-kalsilite-silica) phase diagrams and relevance to magmatic crystallization.

**Unit-III**

Major, trace, REE and isotopic composition of igneous rocks and their implication in petrogenesis and tectonic setting of LMI, MORB, OIB, IA and CFB. Mantle metasomatism, hotspot magmatism. Concept of large igneous provinces with reference to India.

**Unit-IV**

Mode of occurrence, nomenclature, classification and petrogenesis of granites, basalts, ophiolite suite, komatiites, syenites, boninites, anorthosites, peridotite and layered igneous complexes, and alkaline rocks (carbonatite, kimberlite, lamproite, lamprophyre).

  
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**Unit-I**

Weathering & erosion: modes of sediment transport, fluid flow, transport types, movement of particles, settling velocity of sediments, Sedimentary environment-marine, marginal marine, non-marine; fluvial, lacustrine, palustrine. Walter's law; vertical and lateral relationship.

**Unit-II**

Genesis & classification of sedimentary rocks: Siliciclastic rocks-conglomerate, breccias, sandstone, siltstone, claystone and shale. Carbonate rocks-limestone, dolomite, marl, evaporate, 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 analysis; stacking pattern, sediment composition, paleocurrent analysis. Sedimentary basins of India.

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M.Sc. GEOLOGY THIRD SEMESTER

Practical

GEL-311

Duration: 4 hours

Max. Marks 100

**Igneous Petrology:**

**30 Marks**

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.

**Sedimentary Petrology:**

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

**Field work**

**15 Marks**

**Viva-Voce**

**10 Marks**

**Record**

**15 Marks**

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**Unit-I**

Deserts and Dryland Environments, characteristics and distribution around the world and causes of aridity. Hot and cold Deserts, Desert Geology and Geomorphology: sand dunes, type and evolution, lakes and playas, inland drainage basins, ephemeral fluvial systems and nature of deposits. Mineralogy and Geochemistry of desert deposits. Rain Shadow zones.

**Unit-II**


Thar Desert in India: Regional geology and Quaternary geology, Strata-logs and correlations. Morpho-stratigraphy and Geomorphic processes and landscapes. Application of Remote Sensing and Photo geology in study of deserts. Geological evolution and Aeolian landforms. Evolution of Thar deserts.

**Unit-III**

Soils, carcretes and gypcretes. Fauna and flora of dryland environments, conservation of natural resources. Mineral wealth and its utilization/ extraction (mining) water resources and health hazard. Indira Gandhi Nahar Pariyojna, Climate change and Palaeoclimate studies. Impact of global warming. Geoarchaeology, radio Carbon and OSL Dating Techniques for desert deposits.

**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.

  
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**Unit-I**

Petroleum: chemical composition and physical properties of natural crude oil. Origin of petroleum. Maturation of Kerogen, biogenic and thermal effects. Formation of petroleum in relation to geological processes: temperature, time, and pressure. Petrophysical properties of reservoirs: porosity, permeability and capillary pressure. Classification of clastic and carbonate reservoirs. Migration of oil and gas. Trapping mechanism for oil and gas.

**Unit-II**

Petroleum exploration- surface indication of oil and gas, sequence of exploratory steps. Formation evaluation: well-logging, types of well logs, interpretation of lithology from well logs.

Classification of Indian Basins. Geology of productive oil and gas fields of India. Plate Tectonics and global distribution of hydrocarbon reserves. Hydrocarbon Basins of Rajasthan.

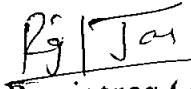
Introduction of nonconventional Petroleum resources: gas hydrates, oil shales, shale gas.

**Unit-III**

Definition, origin, rank, and types of coal. Coalification process and its causes. Physical and petrographic characters: concept of Lithotypes, microlithotypes, and macerals and their physical, chemical and optical properties. Chemical characterization: proximate and ultimate analyses. Mineral and organic matter in coal.

**Unit-IV**

Application of coal petrology in solving geological problems and in hydrocarbon exploration. Coal forming epochs in geological past, coal deposits of India and their distribution. Methods of Coal prospecting and estimation of its reserves. Coal bed Methane: generation and exploration of coal as reservoir of methane.

  
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**Unit-I**

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

**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 labeling of samples.

Field and lab tests Field, 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).

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M.Sc. GEOLOGY THIRD SEMESTER

Practical

GEL-CO4

Duration: 4 hours

Max. Marks 100

**Coal and Petroleum Geology**

**30 Marks**

Panel and fence diagram. Preparation of structural contour map and isopach maps of reservoir facies. Problems on porosity and permeability. Interpretation of different well logs.

Megascopic studies of different varieties of coal. Interpretation of geologic structures from surface geological maps and borehole data.

**Desert Geology:**

Identification and description of desert related geomorphological features

**Project work**

**15 Marks**

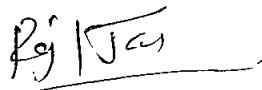
Project in consultation with supervisor to be nominated among the faculty members on mutually agreed topic. The candidate has to submit project report in form of a dissertation for evaluation and award of marks.

**Viva-Voce**

**10 Marks**

**Record**

**15 Marks**

  
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## Course Structure

### Semester -4

S. No.	Subject code	Course title	Course category	Credit	Contact hours per week	EoSE duration (Hrs.)
					L-T-P	Thy-P
1.	GEL 401	Metamorphic Petrology	CCC	4	4-0-0	3-0
2.	GEL 402	Resource Geology	CCC	4	4-0-0	3-0
3.	GEL 403	Environmental Geology & Hydrogeology	CCC	4	4-0-0	3-0
4.	GEL 411	Lab-I Metamorphic Petrology, Resource Geology, Environmental Geology & Field Training	CCC	6	0-0-8	0-4
Total credits in the semester				18		

### Semester -4 Elective


S. No.	Subject code	Course title	Course category	Credit	Contact hours per week	EoSE duration (Hrs.)
					L-T-P	Thy-P
1.	GEL D01	Disaster Management	ECC	4	4-0-0	3-0
2.	GEL D02	Geoinformatics	ECC	4	4-0-0	3-0
3.	GEL D03	Ground water exploration & Management	ECC	4	4-0-0	3-0
4.	GEL D04	Lab-I Ground water exploration, Geoinformatics and Disaster Management	ECC	6	0-0-8	0-4
Total credits in the semester				18		

  
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Semester -4

S. No.	Course code	Core Subjects	Course category	Credit
1.	GEL 401	Metamorphic Petrology	CCC	4
2.	GEL 402	Resource Geology	CCC	4
3.	GEL 403	Environmental Geology & Hydrogeology	CCC	4
4.	GEL 411	Lab-I Metamorphic Petrology, Resource Geology, Environmental Geology & Field Training	CCC	6

S. No.	Course code	Electives Subjects	Course category	Credit
1.	GEL D01	Disaster Management	ECC	4
2.	GEL D02	Geoinformatics	ECC	4
3.	GEL D03	Ground water exploration & Management	ECC	4
4.	GEL D04	Lab-I Ground water exploration, Geoinformatics and Disaster Management	ECC	6

  
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## Metamorphic Petrology

GEL-401

### Unit I

Concept of metamorphism: agents, kinds, facies, isograds and index minerals. Textures of regional, dynamic, and thermal metamorphic rocks. Metasomatism and Metamorphic differentiation.

### Unit II

Thermodynamics and Kinetics of metamorphic reactions. Graphical representation of metamorphic rocks: tie lines, ACF, AKF, AFM, T-x and phase diagrams, pseudo sections, petrogenetic grids and P-T-t paths and their applications.

### Unit III

Metamorphic facies: zeolite, prehnite-pumpellyite, blueschist, greenschist, amphibolite, granulite, eclogite. Contact metamorphic facies. Progressive regional metamorphism of mafic, ultramafic, pelitic and carbonate rocks.

### Unit IV

Anatexis and migmatization. Geothermobarometry. Metamorphism in relation to magma and orogeny. UHP and UHT metamorphism. Petrographic and petrogenetic studies of migmatites and amphibolites.

  
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**Resource Geology**

**GEL-402**

**Unit I**

Ore bearing fluids, their movement, and deposition. Controls of mineralization. Wall-rock alteration. Structure and texture of ores. Classification of ore deposits.

**Unit II**

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

**Unit III**

Origin, mode of occurrence, uses, geological and geographical distribution of deposits of following metals in India: Fe, Mn, Al, Cr, Au, Cu, Pb, Zn, Ag and atomic minerals.

**Unit IV**

Mode of occurrence, geological and geographic distribution of: Fertilizer, refractory, glass, ceramic, abrasive, gemstone, and, cement minerals.

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**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**

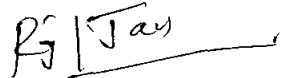
Environmental impact of mining activities ; concept of eco - friendly mining ; laws governing protection of environment and control of pollution ; environmental impact assessment ( EIA ) ; Environmental Management Plan ( EMP )

**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**

Groundwater flow in porous media -Darcy's Law and its application determination of Permeability. Physical and chemical properties of ground water; quality criteria for different uses; groundwater contamination. Saline water Intrusion in coastal areas. Groundwater development; artificial recharge: need and benefits, methods of artificial recharge. Ground water provinces of India with special reference to Rajasthan.

  
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M.Sc. GEOLOGY FOURTH SEMESTER

Practical

GEL-411

Duration: 4 hours

Max. Marks 100

**Metamorphic Petrology:**

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**

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41.

## **Disaster Management**

**GEL-D01**

### **Unit - I**

Objectives and scope - Natural and non natural disasters .Landslides, causes of landslides - hazards pertaining to landslides 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**

Pollution; surface water and subsurface-ground water pollution-strategies for reducing pollution. Impact of radioactive waste disposal on environment. Effects of urbanization, and impact of population explosion. Landfill waste management.

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**Unit I**

Modern Personal Computer-Specifications RAM , CPU and clock speed , Hard disk capacities , network card and data transfer rates , mother boards , Newer multimedia devices - Pen drives , ipods , mobile phones , RFID devices . Playstations, external hard disk, zip drives, DVD drives. Laptop - Palm top.

**Unit II**

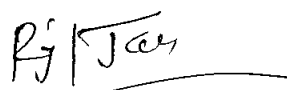
Different operating systems - Windows: NT, XP and Vista - Linux: Ubuntu, Fedora etc. Office packages, Internet browsers. Wikipedia, Scribed, podcasts, bit torrents etc as learning tools. Plagiarism - what constitutes it. Introduction to GPS. Basic idea of GPS. GPS satellites. Control centres. Types of GPS receivers. Uses of GPS. Worldwide digital network GPS.

**Unit III**

Types and nature of spatial data in geology and hydrogeology. Introduction to GIS. History of the development of GIS. GIS related softwares, Map info- Vertical map the structure of GIS. Data representation in GIS - points, lines, polygons. Popular GIS initiatives: Google maps, Google earth.

**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 e contour map. Applications of GIS in water quality, land use and soil bohonetc. Creation of buffer.

  
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## Ground water exploration and Management

GEL-D03

### Unit-I

Origin- meteoritic, 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 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.

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M.Sc. GEOLOGY FOURTH SEMESTER

Practical

GEL-D04

Duration: 4 hours

Max. Marks 100

**Practical 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-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**

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45.