

UNIVERSITY OF RAJASTHAN,
JAIPUR

M.A./M.SC./M.COM

(*Geology*)

2013-2014 (PREVIOUS)-I/II SEMESTER

2014-2015 (FINAL)- III/IV SEMESTER

Prepared by

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16/19

Checked by

DP
24/19

4.9	69	2.9	49	0.9	28.2
4.8	68	2.8	48	0.8	27.4
4.7	67	2.7	47	0.7	26.6
4.6	66	2.6	46	0.6	25.8
4.5	65	2.5	45	0.5	25
4.4	64	2.4	43.8	0.4	20
4.3	63	2.3	42.6	0.3	15
4.2	62	2.2	41.4	0.2	10
4.1	61	2.1	40.2	0.1	5

The enhancement of CGPA by 0.01 will enhance percentage as given below:

Grade	SGPA or CGPA	Percentage enhancement on 0.01 CGPA enhancement
O	5.50 to 6.00	0.5
A	4.50 to 5.49	0.1
B	3.50 to 4.49	0.1
C	2.50 to 3.49	0.1
D	1.50 to 2.49	0.12
E	0.50 to 1.49	0.08
F	0.00 to 0.49	0.5

For example (i) CGPA of 5.73 is equivalent to 86.5%, (ii) CGPA of 5.12 is equivalent to 71.2%, (iii) CGPA of 4.34 is equivalent to 63.4%, (iv) CGPA of 3.26 is equivalent to 52.6%, (v) CGPA of 2.17 is equivalent to 41.04%, and (vi) CGPA of 1.11 is equivalent to 29.88% .

2. Eligibility:

A candidate who has secured more than 50% or CGPA of 3.0 in the UGC Seven Point scale [45% or CGPA 2.5 in the UGC Seven Point Scale for SC/ST/Non-creamy layer OBC] or equivalent in the Bachelor degree in Science or Engineering or Technology or

As given in prospectus of the Univ. Website

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Medicine or Pharmaceutical Science shall be eligible for admission to First Semester of a Master of Science course.

3. Scheme of Examination:

~~Each Course will have component of Continuous assessment carrying 30 marks.~~

Each theory Course EoSE shall carry 100 marks. The EoSE will be of 3 hours duration.

Part 'A' of Paper shall contain 10 questions of ^{20 marks} ~~short answers (one sentence)~~ based on knowledge, understanding and application of the topic covered in the syllabus. Each question will carry two marks for correct answer.

Part "B" of paper will contain 4 questions, one from each unit with internal choice. Each question will carry 20 marks.

Each Practical Course EoSE shall carry 100 marks. Each Practical Course EoSE shall be of four hours duration and involve laboratory experiment / exercises, and viva-voce examination, record with weightage in ratio of 75:25 (15% record 10% viva- Voce).

Note: Field training course in each semester will carry 15 marks and shall be evaluated as part of one of the practical courses of the relevant semester.

4. Course Structure:

The details of the courses with code, title and the credits assign are as given below.

Abbreviations Used

Course Category

CCC: Compulsory Core Course

ECC: Elective Core Course

OEC: Open Elective Course

SC: Supportive Course

SSC: Self Study Core Course

SEM: Seminar

PRJ: Project Work

RP: Research Publication

Contact Hours

L: Lecture

T: Tutorial

P: Practical or Other

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S: Self Study

Relative Weights

IA: Internal Assessment (Attendance/Classroom Participation/Quiz/Home Assignment etc.)

ST: Sessional Test

EoSE: End of Semester Examination

First Semester First Semester

S. No.	Subject Code	Course Title	Course Category	Credit	Contact Hours Per week			EoSE Duration (Hrs.)	
					L	T	P	Th y	P
1.	Gel 101	Tectonics and Geomorphology	CCC	4	4	0	0	3	0
2.	Gel 102	Mineralogy	CCC	4	4	0	0	3	0
3.	Gel 103	Palaeontology -I	CCC	4	4	0	0	3	0
4.	Gel 104	Precambrian Stratigraphy	CCC	4	4	0	0	3	0
5.	Gel 111	Practical -I (Tectonics and Geomorphology , Mineralogy)	CCC	8	0	0	12	0	4
6.	Gel 112	Practical -II (Palaontology, Precambrian Stratigraphy)	CCC	8	0	0	12	0	4
7.	Gel 113	Field Training of 10 day (90 hrs)	CCC	4	0	0	0	0	*

* To be conducted with GEL 112

Second Semester

S. No.	Subject Code	Course Title	Course Category	Credit	Contact Hours Per week			EoSE Duration (Hrs.)	
					L	T	P	Thy	P
1.	Gel 201	Structural Geology	CCC	4	4	0	0	3	0
2.	Gel 202	Geochemistry	CCC	4	4	0	0	3	0
3.	Gel 203	Palaeontology – II	CCC	4	4	0	0	3	0
4.	Gel 204	Phanerozoic Stratigraphy	CCC	4	4	0	0	3	0
5.	Gel 211	Practical-I (Structural Geology, Geochemistry)	CCC	8	0	0	12	0	4
6.	Gel 212	Practical-II (Palaeontology, Stratigraphy)	CCC	8	0	0	12	0	4
7.	Gel 213	Field Training of 10 days (90 hrs)	CCC	4	0	0	0	0	*

* To be conducted with GEL 211

Third Semester

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 Resources	CCC	4	4	0	0	3	0
2.	Gel 302	Igneous Petrology	CCC	4	4	0	0	3	0

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3.	Gel 303	Sedimentary Petrology	CCC	4	4	0	0	3	0
4.	Gel 304	Ground Water Geology	CCC	4	4	0	0	3	0
5.	Gel 311	Practical -I (Mineral Resources Ground Water Geology)	CCC	8	0	0	12	0	4
6.	Gel 312	Practical -II (Igneous and Sedimentary Petrology)	CCC	8	0	0	12	0	4
7.	Gel 313	Field Training of 10 days (90 hrs)	CCC	4	0	0	0	0	*

* To be conducted with GEL 311

Fourth Semester

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	Mineral Exploration & Mining Geology	CCC	4	4	0	0	3	0
3.	Gel 403	Photo-geology Remote Sensing	CCC	4	4	0	0	3	0
4.	Gel 404	Environmental Geology & Disaster Management	CCC	4	4	0	0	3	0
5.	Gel 411	Practical-I (Metamorphic Petrology, Mineral Exploration & Mining Geology)	CCC	8	0	0	1 2	0	4
6.	Gel 412	Practical -II (Photo-geology Remote Sensing , Environmental Geology & Disaster Management)	CCC	8	0	0	1 2	0	4

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7.	Gel 413	Field Training of 10 days (90 hrs)	CCC	4	0	0	0	0	*
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* To be conducted with GEL 411

Note: Field Training Programs are Compulsory. Student not taking part in the field Training shall not be allowed to appear at the EoSE.

1. Gel 101 - Tectonics and Geomorphology

Unit - I

Earth as a dynamic system. Internal constitution of the Earth; heterogeneity of the Earth; seismic, gravity and magnetic characteristics. Continental drift, sea-floor 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

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- IV

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

References Books:-

- Allen, P., 1997: Earth Surface Processes, Blackwell*
Badgely, P.C., 1965: Structure and Tectonics. Harper and Row.
Goodwin, A.M., 1991: Precambrian Geology: The Dynamic Evolution of Continental Crust. Academic Press
Keary, P. and Vine, F.J., 1990: Global Tectonics. Blackwell
Moore, E and Twiss. R.J., 1995: Tectonics. Freeman
Patwardhan, A. M., 1999: The Dynamic Earth System. Prentice Hall
Storetvedt, K.N., 1997: Our Evolving Planet: Earth's History in Perspective. Bergen (Norway), Alma Mater Forlag
Summerfield, M.A., 2000: Geomorphology and Global tectonic. Springer Verlag.
Tarling, D.H., 1983: palaeomagnetism - Principal and Applications in Geology, Geophysics and Archaeology, Chapman and Hall.
Valdia, K.S., 1988: Dynamic Himalaya. Universities Press, Hyderabad

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Gel 102 - Mineralogy

Unit- I

Polarized light, Nicol prism and 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 olivine, garnet, pyroxene and amphibole group of minerals

Unit- III

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

Unit- IV

Stereographic projection, Introduction to X-Ray and its application in study of minerals. Bragg's Law, The powder and single crystal method. Study of precious and semiprecious minerals.

References Books:-

- Deer, W.A., Howise, R.A. and Zussman, J. 1996: The Rock Forming Minerals. Longman*
Klein, C. and Hurlbut, Jr., C.S., 1993: Manual of Mineralogy. John Wiley
Phillips, Wm, R. and Griffen, D.T., 1986: Optical Mineralogy, CBS Edition
Putnis, Andrew, 1992: Introduction to Mineral Sciences. Cambridge University Press
Spear, F.S. 1993: Mineralogical phase Equilibrium and Pressure – Temperature- Time Paths. Mineralogical Society of America Publ.

Gel 103 - Paleontology

Unit I

Origin of life, origin of metazoan. Taxonomy: classification and species nomenclature, species concept. Migration, dispersion and extinction of animals and plants.

Unit II

Theories, mechanism and evidences of evolution. Evidences of life during Precambrian. Major events in the history of Paleozoic, Mesozoic and Cenozoic life.

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. Outline of classification of invertebrates fossils. Application of the following groups of fossils in stratigraphy and stratigraphic correlation/ reconstruction of palaeoenvironment Foraminifers, Radiolarian, Serpulids, Conodonts, Ostracodes

Unit IV

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.

References Books:-

- Age, D.V., 1963: *Principal of palaeoecology*. McGraw Hill
- Age, D.V., 1980: *Introduction to palaeoecology*. McGraw Hill
- Bignot, G., 1985: *Elements of Micropalaeontology*. Graham and Trotman
- Block, R.M., 1970: *The elements of palaeoecology* Cambridge University Press, London, PP. 404.
- Clarkson, E.N.K., 1998: *Invertebrate paleontology and Evolution*. IV Ed. Blackwell
- Dodd, J.R. and Stanton, R.J., 1983: *palaeoecology: Concepts and Application*. John Wiley
- Glaessner, M.F, 1972: *Principals of Micropalaeontology*. Hafner publishing Company.
- Haq, B. V. and Boersma, A., 1988: *Introduction to Marine Micropalaeontology*. Elsevier
- Haynes, J. R., 1981: *Forminifera*. John Wiley
- Kathal, P.K. 1998: *Microfossils & their applications*. C B S Publishers & Distributors.
- Kennett, P. and Ross, C.A., 1983: *palaeoecology*. Longman
- Ladd, H. S., 1957: *Trestise on Marine Ecology & Palaeoecology*, Vol. 2 (Palaeoecology), Mem. Geology Soc. America
- McKerrow, W. S., 1984: *The Ecology of Fossils*. Duckowrth
- Moore, R.C., Lalicker, C.G. and Fisher, A.G.: *Invertebrate Fossils*. McGraw Hill
- Moore: *Treatise on Intertebrate palaeoecology (Separate parts for different Classes)*
- Raup, D.M. and Stanley, S.M. 1985: *Principals of palaeoecology*, C.B.S.
- Shrock and Twenhofel : *Principal of invertebrate palaeontology*.
- Smith, A.B., 1994: *Systematic and the Fossils Record – Documneting Evolutionary Pattern*. Blackwell
- Stearn, C.W. & Carroll, R.L., 1989: *palaeoecology – the Record of Life*. John Wiley
- Swinerton, H.H.: *Outlines of palaeoecology*.
- Turner, F.J. and Weiss, L.E., 1963: *Mordern Structural Analysis of Metamorphic Tectonics*. McGraw Hill

Gel 104 - Principles & Precambrian Stratigraphy

Unit I

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

Unit II

Early history of the earth, nature and evolution of early crust. Evolution of Granite- Greenstone and Granulites belts. Precambrian provinces of India. Distribution, stratigraphic correlation, succession, structure geochronology and economic importance Archean groups of rocks. Archean and Proterozoic tectonic patterns.

Unit III

Precambrian Stratigraphic belts. Precambrian Geology of Greenland, Canadian Shield, Rhodesian Craton, Western Australia and Baltic Shield with their equivalents in Indian shield.

Unit IV

Proterozoic Sedimentary Basins of India. Distribution, classification, succession, economic importance and age of Cuddapah and Vindhyan supergroups. Nature and form of Precambrian life. Major episodes and breaks in Precambrian Stratigraphy. Methods of Correlation of Precambrian rocks.

References Books:-

- Bayer, U. and Seilacher, A., 1985: Sedimentary and Stratigraphy and Evolutionary Cycles. Springer Verlag*
- Brenner, R.L. and Mctargue, T.R., 1988: Integrative Stratigraphy: Concepts and Application. Prentice hall*
- Brenner, R.L. and Mcttarque, T.R., 1988: Integrative Stratigraphy and Application. John Wiley*
- Doyle, P. and Bennett, M.R., 1986: Unlocking the Stratigraphic Record. Johan Wiley*
- Gupta V.J. 1977: Indian Precambrian Stratigraphy. Hindusthan Publishing Corporation Ltd.*
- Krishnan M.S. : Geology of India and Burma. Higginbothams (P) Ltd.*
- Lemon R.R. 1990: Principles of Stratigraphy. Merrill Publishing Company.*
- Miall, A.D. 1997: The Geology of Stratigraphic Sequences. Springer Verlag*
- Naqvi, S.M. and Rogers , J.J.W., 1987: Precambrian Geology og India, Oxford University Press*
- Pascoe, E.H., 1986: A Manual of Geology of India and Burma, Vol , I – IV, Govt. of India Press*
- Rankama, K.1967: The Precambrians, Vol 1,2 &3. Interscience Publishers, John Wiley & Sons Inc.*
- Ravindra Kumar 1988; Fundamentals of Historical Geology and Stratigraphy of India. New Age International Publishers.*
- Sheriff, R.E., 1980: Seismic Stratigraphy. Internat. Human Resources Dev. Corp. Boston.*

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Gel 111 - Practical-I

Tectonics and Geomorphology

1. Identification and description of various landforms.
2. Morphometric analysis of drainage basins.
3. Studies of drainage patterns.
4. Exercises on Slope analysis.

Mineralogy:-

1. Determination of axial ratio.
2. Identification of minerals in hand specimen.
3. Microscopic properties of minerals with emphasis on pleochroic scheme, identification of interference figures and optical sign, determination and measurement of 2V.

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Record

Gel 112 - Practical-II

Palaeontology:

Labeled 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

Stratigraphy:

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

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Gel 113 - Field work

Record

Compulsory Field Training Program : Geological Field Training

- 10 days duration



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Note: Field Training is Compulsory, Student not taking part in the field training shall not be allowed to appear in the examination.

Gel 201 - Structural Geology

Unit-I

Primary sedimentary and igneous structures, Gravity related features and their usefulness in structural analyses. Unconformities and basement cover relationship. Principles of geological mapping, projection diagrams.

Unit-II

Stress, Strain, Stress-strain relationship of elastic, plastic and viscous materials. Mechanical behaviour of rocks. Measurement of strain in deformed rocks. Time relationship between crystallization and deformations.

Unit-III

Folds: Geometry, classification, mechanism of folding. Superimposed folds: occurrence, recognition and geometric analyses. Cleavage: Types, origin, mechanics and relationship with folding.

Unit-IV

Faults: Geometry, classification, mechanism of faulting. Shear zones, Shear sense indicators, shear zone kinematics. Role of fluids. Joints: Relation of joints and fractures to strain field. Lineation: Types, origin and deformation. Basic principles of structural analyses.

References Books:-

- Bayly B., 1992: Mechanics in Structure Geology. Springer Verlag*
Davis, G.R., 1984: Structural Geology of Rocks and Region. John Wiley
Ghosh S.K., 1995: Structural Geology Fundamentals of Morder Development. Persimmon Press
Hobbs, B.E., Means, W.D. and Williams, P.F., 1976: An Outline of Structural Geology, John Wiley
Price, N, J. and Cosgrove, J.W., 1990: Analysis of Geological Structure. Cambridge univ. Press.
Ramsay, J.G. and Huber, M.I., 1987: Modern Structure Geology, Vol. I & II. Academic Press
Ramsay, J.G., 1967: Folding and Fracturing of Rocks. Mc Graw Hill.

Gel 202 - Geochemistry

UNIT - I

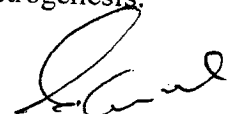
Atomic structure, periodic table and properties of elements. Silicate structures; Isomorphism, polymorphism, solid solution and exsolution.

UNIT - II

Structure and composition of earth and distribution of elements; Geochemical classification of elements. Geochemical cycle. Earth in relation to solar system and universe, Cosmic abundance of element

UNIT-III

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.



UNIT - IV

Isotope geochemistry: Radiogenic and stable isotope. Concept and application of C-, and O- and H isotopes. Geochronologic application of Rb - Sr, U - Pb and Ar - Ar systematics.

References Books:-

- Barnes, H.L., 1979: Geochemistry of Hydrothermal Ore Deposits. John Wiley*
Faure, G., 1986: Principal of Isotope Geology. John Wiley
Henderson, P., 1987: Inorganic Geochemistry, Pergamon Press.
Hoefs, J., 1980: Stable Isotope Geochemistry. Springer Verlag
Koch, G.S. and Kink, R.F., 1970: Statistical Analysis of Geological Data. John Wiley
Krauskopf, K.B., 1967: Introduction to Geochemistry. McGraw hill
Marshal, C.P. and Fairbridge, R.W., 1999: Encyclopaedia of Geochemistry. Kluwer Academic
Mason, B. and Moore, C.B., 1991: Introduction to Geochemistry, Wiley Eastern
Nordstrom, D.K. and Munoz, J.L., 1986: Geochemical Thermodynamics, Blackwell

Gel 203 - Paleontology -II

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

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

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 vertebrates through geological ages. Evolutionary history of man, elephant and horse. Extinction of Dinosaurs.

References Books:-

- Colbert, E.H. Outline of the Vertebrates. Johan Wile & Sons*
Gupta V.J. 1973 : Indian Palaeozoic Stratigraphy. Hindusthan Publishing Corporation Ltd.
Prothero, D.R., 1998: Bringing Fossils to Life - An Introduction to palaeoecology. McGraw Hill

Gel 204 - Phanerozoic Stratigraphy

Unit - I

Palaeozoic sediments of India: their nomenclature, classification, distribution, structures, succession, sedimentary history, fauna, flora, age, igneous intrusion, palaeogeography, palaeoclimate and regional correlation. Permian- Triassic boundary.

Unit- II

Mesozoic sediments of India: their nomenclature, classification, distribution, succession, sedimentary history, fauna, flora, age, igneous intrusion, palaeogeography, palaeoclimate and regional correlation. Cretaceous/ Tertiary (K/T) Boundary.

Unit- III

Gondwana Supergroup of India: Nomenclature, classification, distribution, structures, succession, sedimentary history, fauna, flora, age, igneous intrusion, palaeogeography, palaeoclimate and regional correlation.

Deccan Volcanic Province: Stratigraphy, Field Features of Basalt flows, petrology and petrogenesis, age and duration of volcanism. Inter - Trappeans and associated sedimentary formations and their fossils.

Unit - IV

Cenozoic sediments of India: their nomenclature classification distribution magmatic activity, succession, sedimentary history, fauna, flora, age, palaeogeography, palaeoclimate and regional correlation. Geology of off shore basins of India. Classification, distribution, fossils and age of Siwaliks.

References Books:-

- Gupta V.J. 1975: Indian Mesozoic Stratigraphy. Hindusthan Publishing Corporation Ltd.*
Gupta V.J. 1976: Indian Cenozoic Stratigraphy. Hindusthan Publishing Corporation Ltd.
Moullade, M. and A.E.M., 1983: Vol. I: Paleozoic; Vol. II: Mesozoic A & B; Vol. III: Cenozoic. Elsevier
Moullade, M. and Nairn, A.E.M., 1983: Vol. I: Palaeozoic; Vol. II Mesozoic A & B; Vol. III: Cenozoic. Elsevier.
Pomerol, C., 1982 : The Cenozoic Era: Tertiary and Quaternary. Ellis Harwood Ltd.

Gel 211 - Practical-I

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 stereonet: S-pole and beta-pole diagrams; Fold axis and axial plane;

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diagrams; Methodology and interpretation of patterns.

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

Geochemistry

5. Graphical presentation of geochemical data.

Calculation of important mineral formula from chemical analysis.

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Gel 212 - Practical-II

Palaentology – II :

Labeled 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

Phanerozoic Stratigraphy:

Identification, description and geochronology of Indian phanerozoic stratigraphic rocks.

Phanerozoic Stratigraphic maps of India.

Phenerozoic Palaeogeographic maps of India.

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Record

Gel 213 - Field

Record

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

Note: **Field Training is Compulsory. Student not taking part in the field training shall not be allowed to appear in the examination**

Gel 301 - Mineral Resources

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.

References Books:-

- Payton, C. E., 1977: Seismic Stratigraphy – Applications to Hydrocarbon Exploration. Amer. Assoc. Petrol. Geology*
- Chandra, D., Singh, R.M. and Singh, M.P., 2000: Textbook of Coal (Indian Context.) Tara Book Agency, Varanasi*
- Craig, J.M. & Vaughan, D.J., 1981: Ore Petrography and Mineralogy. John Wiley*
- Dahlkamp, F.J., 1993: Uranium Ore Deposits. Springer Verlag*
- Durrance, E.M., 1986: Radioactivity in Geology. Principal and Application. Ellis Hoorwool*
- Evans, A.M., 1993: Ore Geology and Industrial Mineral. Blackwell*
- Guilbert, J.M. and Park, Jr. C.F., 1986: The Geology of Deposits. Freeman*
- Holson, G.D. and Tiratsoo, E.N., 1985: Introduction to Petroleum Geology. Gulf Publ. Houston, Texas*
- Jansen M.L. & Bateman A.M.: 1981, Economic Mineral Deposits, John Wiley & Sons, Singapore*
- Klemm, D.D. and Schneider, H.J., 1977: Time and Strata Bound Ore Deposits. Springer Verlag*
- Mookherjee, A., 2000: Ore Genesis – a Holistic Approach. Allied Publisher*
- Payton, C. E., 1977: Seismic Stratigraphy – Applications to Hydrocarbon Exploration Geology. Oxford & IBM Publishing Company*
- Ramdohr, P., 1969: The Ore Minerals and Their Intergrowths. Peragamon press*
- Sawkins, F.J., 1984: Metal Deposits in Relation to Plate Tectonics. Springer Verlag*
- Selley, R.C., 1998: Elements of Petroleum Geology. Academic Press*
- Singh, M.P.(Ed.), 1998: Coal and Organic Petrology. Hindustan Publ., New Delhi*



Stach, E., Mackpowsky, M.T.H., Taylor G.H., Chandra, D., Teichmuller, M., and Stanton, R.L., 1972: Ore Petrology, McGraw Hill

Taylor, G.H., Teichmuller, M., Davis, A., Diessel, C. F.K., Littke, R. and Robert, P., 1998: Organic Petrology. Gebruder Borntraeger, Stuttgart

Teichmukker. R., 1982: Stach' s Text Book of Coal Petrology. Gebruder Borntraeger, Stuttgart

Tissot, B.P. and Welte, D.H., 1984: Petroleum EFormation and Occurrence. Springer Verlag

Torlin, D.H., 1981: Economic Geology and Geotectonic. Blackwell Sci Publ.

Wolf, K.H., 1976-81: Hand Book of Stratabound and Stratiform Ore Deposits. Elsevier

Gel 302 - Igneous Petrology

Unit - I

Magma: Origin, composition and constitution. Emplacement and its relation to plate tectonics; Reaction Principle, magmatic crystallization, differentiation and assimilation. Igneous Rocks: intrusive and extrusive forms. Texture and Structures of Igneous rocks and their petrogenetic significance

Unit - II

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

Unit - III

Major, trace, REE and Isotopic compositions of igneous rocks and their role in petrogenesis and tectonic setting. Origin of major igneous rock types viz Granites, Basalts and Alkaline rocks; Ophiolites and Carbonatites.

Unit - IV

Mode of occurrence, nomenclature, classification and petrogenesis of the following rock groups: Granite - Granodiorite - Diorite; Rhyolite - Rhyodacite - Dacite; Gabbro - Dolerite - Basalt; Syenite - felspathoidal syenites; Ultramafic rocks; Pegmatites.

References Books:-

Best, M.G., 1986: Igneous Petrology, CBS Publ.

Bose, M.K., 1997: Igneous Petrology. World Press

Hall, A.: Igneous Petrology.

Hutchinson, C.S., 1974: Laboratory Handbook of petrographic Techniques. John Wiley

McBriney, A.R., 1993: Igneous Petrology. Jones & Bartelt Publ.

Perchuk, L.L. and Kushiro, I. (eds), 1991: Physical Chemistry of Magmas. Springer Verlag

Philipotts, A., 1992: Igneous and Metamorphic Petrology. Prentice Hall



Powell, R., 1978: Equilibrium Thermodynamics in Petrology, an Introduction. Harper & Row
Wood, B.J. and Fraser, D.G., 1976: Elementary thermodynamics for Geologists. Oxford University Press

Gel 303 - Sedimentary Petrology

Unit - I

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

Unit - II

Genesis & classification of sedimentary rocks: Siliciclastic rocks - conglomerate, breccia, sandstone, siltstone, claystone and shale. Carbonate rock - 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 element, rare-earth element and stable isotope geochemistry to sedimentological problems.

Unit - IV

Tectonics and sedimentation: classification, definition and description of sedimentary basins, paleocurrent analysis and its application in basin analysis. Sedimentary basins of India.

References Books:-

- Allen, J. R. L., 1985 Principles of Physical Sedimentation, George Allen & Unwin*
Bayer, U. and Seilacher, A., 1985: Sedimentary and Evolutionary Cycles. Springer- Verlag.
Bhattacharya, A and Chakraborti, C., 2000: Analysis of Sedimentary Succession. Oxford - IBH
Blatt, H, Murray, G.V. and Middleton, R.C., 1980: Origin of Sedimentary Rocks
Boggs Sam Jr., 1985: Principles of Sedimentary and Stratigraphy, Prentice
Cover, R.E. 1971 : Procedures in Sedimentary Petrology. Wiley Interscience, John Wiley
Davis, R.A. Jr., 1992: Davis, R.A. Jr., 1992: Depositional System. Prentice Hall
Einsele, G., 1992: Sedimentary Basins. Springer Verlag
Friedman, G.M. and Sander, J.E., 1978: Principles of Sedimentology. John Wiley
Guy Plint, A., 1995: Sedimentary Facies Analysis. Spi. Publ IAS No. 22, Blackwell
Miall, A.D. 1996: The Geology of Fluvial Deposits Springer Verlag
Miall, A.D., 2000: Principles of Sedimentary Basins Analysis, Springer Verlag
Nichols, G., 1990: Sedimentology and Stratigraphy. Blackwell
Pettijohn, F.J., Potter, P.E. and Siever, R., 1990: Sand and Sandstone. Springer Verlag



Prothero, D.R. and Schwab, F., 1996 : Sedimentary Geology. Freeman

Reading, H.G., 1996: Sedimentary Environments. Blackwell

Reineck, H.E. and Singh, I.B., 1980: Depositional Sedimentary Environments. Springer Verlag

Sengupta, S., 1997: Introduction to Sedimentology. Oxford – IBH

Tucker, M., 1988: Techniques in Sedimentology. Blackwell

Gel 304 - Ground Water Geology

Unit – I

Ground Water Geology, Importance of ground water, Elements of ground water hydrology. Sources of ground water and origin, hydrological cycle. Occurrence and distribution of ground water. Aquifer and its hydrological properties.

Unit –II

Exploration and Evaluation of ground water. Hydrologic investigation; surface geophysical methods, seismic methods, electric resistivity methods. Introduction to sub- surface geophysical methods Theory of groundwater flow, Darcy's law and its application, determination of permeability in laboratory and in field, Types of wells, ground water modeling; Numerical and electrical methods. Ground water quality: factors affecting quality of ground water, analyses of ground water. .

Unit – III

Ground water use in domestic, agriculture and industrial sector. Saline and fresh water interface. Artificial recharge: need and benefits, methods of artificial recharge; Concept of ground water basin, hydraulic conductivity, transmissivity, storage coefficient, water table fluctuation, causative factors, concept of barometric and fidal efficiency, water table contour map.

Unit- IV

Ground water problems related to foundation work, mining, canals and tunnels, problem of overexploitation and groundwater mining, groundwater development in urban areas, rain water harvesting, groundwater potentials of Rajasthan, Sustainability of groundwater resources. Groundwater and Sustainable Development. Ground water provinces with respect to Hydrogeology of India. Wet lands with special reference to Rajasthan.

References Books:-

Alley, W.M., 1993: Regional Groundwater Quality. VNR, New York

Black, W. & Others (ED.), 1989: Hydrogeology. Geol. Soc. Of America Publ.

Davies, S.N. & De Wiest, R.J.M., 1966: Hydrogeology. John wiley

Fetter, C. W., 1990: Applied Hydrogeology, Merrill

Freeze, R. A. & Cherry, J.A., 1979: Groundwater. Prentice Hall



Karanth, K.R., 1987: Groundwater Assessment – Development and Management. Tata McGraw Hill

Mahajan, G., 1990: Evaluation and Development of Groundwater

Raghunath, N.M., 1982: Groundwater. Wiley Eastern

Singhal, B.B.S., 1986: Engineering Geosciences. Savita Prakashn

Subramaniam, V., 2000: Water. Kingston Publ. London

Todd, D.K., 1980: Groundwater Hydrology. John Wiley

Walton, W. C., 188: Groundwater Resources Evaluation. McGraw Hill

Gel 311 - Practical-I

Mineral Resources:

1. Study of economic minerals in hand specimen.
2. Important world and Indian deposits to be plotted on maps.
3. Study of important ore minerals under reflected light microscope.

Groundwater :

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

Viva-Voce

Gel 312 - Practical-II

Igneous Petrology:

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

Sedimentary Petrology:

1. Identification and description of important sedimentary rocks in hand specimen.
2. Petrographic studies of important sedimentary rocks.
3. Graphic representation of data, histogram, cumulative curves, frequency curves, rose diagram, star symbols.

Viva-Voce

Record



313 - Field work

Record

Compulsory Field Training Program : Geological Study Tour

- 10 days duration.

Note: Field Training is Compulsory, Student not taking part in the field training shall not be allowed to appear in the examination

Gel 401- Metamorphic Petrology

UNIT - I

Agents and kinds of metamorphism; metamorphic zones; grades; iso-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. Studies of metamorphic facies: zeolite facies; pumpellyite-prehnite facies; glaucophane 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.

References Books:-

Bucher, K. and Frey, M. 1984: Petrogenesis of Metamorphic Rocks, Springer Verlag

Kretz, R., 1994: Metamorphic Crystallization, John Wiley

Philipotts, A., 1992: Igneous and Metamorphic Petrology. Prentice Hall

Powell, R., 1978: Equilibrium Thermodynamics in Petrology, an Introduction. Harper & Row

Wood, B.J. and Fraser, D.G., 1976: Elementary thermodynamics for Geologist. Oxford University Press

Turner, F.J., 1980: Metamorphic Petrology, McGraw Hill, New York

Yardely, B.W., 1989., An Introduction to Metamorphic Petrology. Longman New York

Gel 402 - Mineral Exploration & Mining Geology

UNIT - I

Guides for locating ore deposits: structural, lithological, stratigraphic and physiographic guides.
Surface prospecting methods: pitting and trenching; Sub-surface exploration: drilling, different types of drilling, use of diamond drilling in exploration; core-logging and assaying; sampling; various methods of sampling.

UNIT - II

Ore reserves and resources: definition and outline of United Nations International framework classification of mineral reserves and resources; grades and recovery of ores; methods of ore reserve estimations; surface area and cross sectional area methods; recoverable reserves and anticipated life of the deposits.

UNIT - III

Outline of geophysical and geochemical prospecting; role of remote sensing in mineral exploration; 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 involving in selection of open cast and underground mining methods; salient features of bench-mining, shrinkage stopping, sub-level stopping and sub-level top slicing; coal mining methods: room and pillar method, long wall method. Environmental aspects of Mining activities.

References Books:-

- Arogyaswami, R.N.P., 1996: Courses in Mining Geology. Oxford IBH*
Boyle, R.W., 1982: Geochemical Prospecting for Thorium and Uranium Deposits. Elsevier
Clark, G.B., 1967: Elements of Mining. III Ed. John Wiley
Dobrin, M. B., 1976: Introduction to Geophysical Prospecting. McGraw Hill
Govett, G.J.S.(Ed), 1983: Handbook of Exploration Geochemistry Elsevier.
Mckinstry, H. E., 1962: Mining Geology. II Ed. Asia Publishing House
Parasnis, D.S., 1975: Principles of Applied Geophysics. Chapman and Hall
Sharma, P.V., 1986: Geophysical Methods in Geology. Elsevier
Sharma. P.V., 1997: Environmental and engineering Geophysics, Cambridge University Press
Stanislave, M., 1984: Introduction to Applied Geophysics, Reidel Publ.



Gel 403 - Photo geology & Remote Sensing**UNIT - I**

Fundamental principles and technology of aerial photography; Photogrammetry, types & geometry of aerial photographs; factors affecting aerial photography; types of camera, film and filters; scale of aerial photography and factors affecting scale; mosaics and annotation; relief displacement; vertical exaggeration; Stereoscopy; Fundamental principles of radial line triangulation methods; Elements of Photo interpretation; Application of aerial photographs in geoscience and geomorphological studies.

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-III

Types of Indian and Foreign Remote sensing Satellites and their Applicability.
Visual and Digital method of Interpretation; Digital image processing; digital data formats; fundamental steps in image processing; image rectification and restoration; elements of pattern recognition and image classification. Application of Remote sensing in Groundwater, and Mineral Resource investigatio

UNIT - IV

Introduction to Geographic Information System (GIS); components of GIS; product generation in GIS; tools for map analysis; integration of GIS with remote sensing.

References Books:-

- Druy, S.A., 1987: Image Interpretation in Geology. Allen and Unwin*
- Gupta, R.P., 1990: Remote Sensing Geology. Springer Verlag*
- Lilleasand, T.M. and Kiffer, R.W., 1987: Remote Sensing and Image Interpretation, John Wiley*
- Miller, V.C., 1961: Photogeology. McGraw Hill*
- Moffitt, F.H. and Mikhail, E.M., 1980: Photogrammetry, Harper and Row*
- Paine, D.P., 1981: Aerial Photography and image Interpretation for Resources Management. John Wiley*
- Pandey, S.N., 1987: Principles and Application of Photogeology. Wiley Eastern, New Delhi*
- Ray, R.G., 1969: Aerial Photographs in Geologic Interpretation. USGS Prof. Paper 373*
- Sabbins, F.F., 1985: Remote Sensing - Principles and Applications. Freeman*
- Siegal, B.S. and Gillespie, A.R., 1980: Remote Sensing in Geology. John Wiley*

Gel 404 - Environmental Geology & Disaster Management

NIT - I

Environmental Geology: definition and concepts of environmental geology; environmental problems: green house effect and global warming, Global Warming and its consequences, mitigation and adaptation; depletion of ozone layer, acid rain.

UNIT - II

Air pollution: causes, impact and remedial strategies; Noise pollution: causes, impact and remedial strategies; Water pollution: causes, impact and remedial strategies; groundwater pollution and health issues.

UNIT - III

Environmental impacts 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 - IV

Geological Disaster and Geological Hazard , concept and types of disaster, factors, causes and effect of disasters; human behavior and response during disaster; natural hazard (earthquakes , volcanic activities, floods, droughts landslides).

Management and mitigation of disasters. Best Practices in Disaster Mitigation

Books Recommended

Bell, F. G., 1999: Geological Hazards. Routledge, London
Bryant, E., 1985: Natural Hazards, Cambridge University Press
Keller, E. A., 1978: Environmental Geology, Bell and Howell, USA
Krynine, D. H. and Judd, W.R., 1998: Principles of Engineering Geology. CBS Edition
Smith, K. 1992: Environmental Hazards. Routledge, London
Subramaniam, V., 2001: Text Book in Environmental Science, Narosa International.
Valdiya, K.S., 1987: Environmental Geology – Indian Context. Tata McGraw Hill
Vogelsang, D., 1995: Environmental Geophysics – A Practical Guide. Springer Verlag

Gel 411 - Practical - I

Metamorphic Petrology:

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

Mineral Exploration & Mining Geology :

1. Survey by prismatic compass and theodolite.
2. Leveling
3. Use of GPS
4. Bore hole plotting, core logging and correlation.
5. Ore reserves estimation.

Viva-Voce

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Gel 412 - Practical-II

Photo geology & Remote Sensing:

1. Scale and height of aerial photographs.
2. Interpretation of aerial photographs.
3. Visual interpretation of satellite imageries.
4. Image analysis exercises.
5. Applications using GIS software.

Environmental Geology & Disaster Management:

1. Analysis of different parameters of air, water and noise.
2. Interpretation of air, water and noise data.
3. Preparation of iso-concentration maps of water quality parameters.
4. Seismic maps of World, India and Rajasthan.
5. Exercises on slope failure and landslides.

Viva-Voce

Record

Gel 413 - Field work

Record

Compulsory Field Training Program: Geological Study Tour(Min. Expl.& Mining) – 10 days duration

Note: Field Training is Compulsory. Student not taking part in the field training shall not be allowed to appear in the examination

