

Choice Based Credit System
Scheme of M.Sc. Geology Course (2 years duration)
w.e.f. Session 2017-18

M.Sc. Geology (First Semester)

Paper code	Paper Name	Max Marks	Internal Marks	External Marks	Credits
17GE021C1	Geology I	100	20	80	4
17GE021C2	Geology II	100	20	80	4
17GE021C3	Physics and Chemistry of the Earth	100	20	80	4
17GE021CL1	Practical based on 17GE021C1	100	20	80	4
17GE021CL2	Practical based on 17GE021C2 & 17GE021C3	100	20	80	4
17GE021C4	Geological Field Training	100	20	80	4
	Total	600	120	480	24

Note:

- Each theory paper will include 20% marks as internal assessment as per University rules.
- Each practical examination will be of 04 hours.
- Practical marks will include 10% marks for viva-voce and 10% for record files.
- Total credits : 24

M.Sc. Geology Second Semester

Paper code	Paper Name	Max Marks	Internal Marks	External Marks	Credits
17GEO22C1	Mineralogy, Instrumentation and Analytical Techniques	100	20	80	4
17GEO22C2	Structural Geology	100	20	80	4
17GEO22C3	Paleobiology and Micropaleontology	100	20	80	4
17GEO22CL1	Practical based on 17GEO22C1	100	20	80	4
17GEO22CL2	Practical based on 17GEO22C2 & 17GEO22C3	100	20	80	4
17GEO22D1 OR 17GEO22D2	Environmental Geology OR Fuel Geology	100	20	80	4
Foundation Elective	To be chosen from the pool of foundation electives provided by the University	50	10	40	2
Open Elective	To be chosen from the pool of open electives provided by the University	75	15	60	3
	Total	725	145	580	29

Note:

- Each theory paper will include 20% marks as internal assessment as per University rules.
- Each practical examination will be of 04 hours.
- Practical marks will include 10% marks for viva-voce and 10% for record files.
- Total Credits = 29

M.Sc. Geology Third Semester
w.e.f. 2018-19

Paper code	Paper Name	Max Marks	Internal Marks	External Marks	Credits
17GEO23C1	Stratigraphy, Paleogeography and Palaeoecology	100	20	80	4
17GEO23C2	Igneous and Metamorphic Petrology	100	20	80	4
17GEO23CL1	Practical based on 17GEO23C1 & 17GEO23C2	100	20	80	4
17GEO23D1	Opt any two:- Sedimentology and Geomorphology	100	20	80	4
17GEO23D2		100	20	80	4
17GEO23D3	Mining Geology	100	20	80	4
17GEO23DL1	Geotectonics	100	20	80	4
17GEO23DL1	Practical Based on 17GEO23D1, 17GEO23D2, 17GEO23D3	100	20	80	4
17GEO23C4	Geological Field Training	100	20	80	4
Open Elective	To be chosen from the pool of open electives provided by the University	75	15	60	3
	Total	775	155	620	31

Note:

- Each theory paper will include 20% marks as internal assessment as per University rules.
- Each practical examination will be of 04 hours.
- Practical marks will include 10% marks for viva-voce and 10% for record files.
- Total Credits = 31

M.Sc. Geology Fourth Semester

Paper	Paper Name	Maximum Marks	Internal Marks	External Marks	Credits
17GEO24C1	Geochemistry	100	20	80	4
17GEO24C2	Ore Geology and Mineral Economics	100	20	80	4
17GEO24CL1	Practical based on 17GEO24C1 & 17GEO24C2	100	20	80	4
Group-A (Opt any one)					
17GEO24DA1	Geo Hydrology	100	20	80	4
17GEO24DA2	Oceanography and marine Geology	100	20	80	4
Group-B (Opt any two)					
17GEO24DB1	Engineering Geology	100	20	80	4
17GEO24DB2	Geo Exploration	100	20	80	4
17GEO24DB3	Remote Sensing and GIS	100	20	80	4
	Total	600	120	480	24

- Each theory paper will include 20% marks as internal assessment as per University rules.
- Each practical examination will be of 04 hours.
- Practical marks will include 10% marks for viva-voce and 10% for record files.
- Total Credits = 24

M.Sc. Geology (1st Semester)**Paper Code: 17GEO21C1****Geology-I****4 hrs. / Week**

Credits: 04

Max. Marks: 80

Time: 3 Hrs.

Note:-Examiner will set 09 questions and the candidates will be required to attempt 05 questions in all. Out of 09 questions one question will be compulsory containing 08 short answer type questions covering the entire syllabus. Further, examiner will set 02 questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

Section- A

Fundamentals: Definition, objectives and scope, nature of fossil record and their uses, classification of animals, their habits and habitats, evolution of life through the ages, migration, dispersal and extinction of life. Use of microfossil in fossil fuel exploration.

Section- B

Stratigraphic classification, Geological time scale; principles of stratigraphic correlation. Broad outline of physiographic and tectonic framework of India. Tertiary succession of India with bearing in economic deposits. Principles of Stratigraphy.

Section- C

Vertebrate Palaeontology- Basic concepts, broad classification of groups, Basics of Palynology, types of fossil spores and pollen grains and its applications, Applied Aspects of Palynology: Age determination and correlation, Palaeoecological interpretations with case histories.

Section- D

Introduction to Marine Geology, Ocean currents and circulation pattern, turbidity, bottom currents and zones of high planktonic productivity, structural features of ocean floor, marine mineral resources and hydrocarbons in marine sediments.

Books Recommended:

1. "An Introduction to the Study of Fossil Plants", Walton, J.
2. Paleontology Invertebrate", CBS Publications. Woods, H.,
3. "Vertebrate Paleontology", Chapman & Hall. Benton, M.J.,
4. "Paleontology", John Willey & Sons Colbert, R.L.,
5. Shrock & Twinhofel – Invertebrate Paleontology.
6. McGowran, B., "Biostratigraphy: Microfossils & Geological Time", Cambridge University Press.
7. Brassier, "Microfossils"
8. King, C. Introduction to Marine Geology and Geomorphology, Crane Russak.
9. Lal, D. S. Oceanography, Sharada Pustak Mahal

M.Sc. Geology (1st Semester)**Paper Code: 17GEO21C2 Geology-II**

4 hrs. / Week
 Credits: 04
 Max. Marks: 80
 Time: 3 Hrs.

Note:-Examiner will set 09 questions and the candidates will be required to attempt 05 questions in all. Out of 09 questions one question will be compulsory containing 08 short answer type questions covering the entire syllabus. Further, examiner will set 02 questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

Section-A

Chemical nature of mineral; atoms; ions, bonding; co-ordination and crystallinity; isomorphism, solid solution and polymorphism; physical properties of mineral; classification of minerals; common rock forming and ore forming mineral; their physical properties, chemical composition and mode of occurrence. Elements of mineral optics and petrological microscope.

Section-B

Historical development in Geomorphology. Basic concepts and significance of Geomorphology. Denudational processes: Weathering, erosion, transportation, weathering products and soils – profiles & its types.

Fluvial processes on hillslopes. River and drainage basin: Drainage pattern, network characteristics.

Mass wasting processes – classification. Semi-arid and arid environment: Work of wind, Desert landscape.

Section-C

Elements of mining, its methods (Alluvial mining, opencast mining, underground mining) for metallic and nonmetallic ores. Ocean bottom mining.

Role of geologists in mine operations, Blasting and types of explosives. Mine safety measures and mine legislation.

Section-D

Basic principles of environment and eco-system in relation to Geology. Mans activities and their impact on environment. Depleting natural resources and sustainable development, conservation of mineral resources; mitigation of pollution and environmental hazards.

Books Recommended:

1. Introduction to Geomorphology by Vishwas S.Kale & Avijit Gupta.
2. Principles of Geomorphology by W.D. Thornbury
3. "Understanding the earth", W.H. Freeman & Co. Press, F. and Siever, R.,
4. "Physical Geology", Brooks-Cole. by Moore, J.S. and Wicander, R.,
5. "Essentials of Geology", John Wiley & Sons, by Marshak, S.
 "Rutley's Elements of Mineralogy", Twenty-Sixth Edition, George Allen & Unwin Publishers Ltd – 1970 by Read, H.H.

M.Sc. Geology (1st Semester)

Paper Code: 17GEO21C3 Physics and Chemistry of the Earth

4 hrs. / Week
Credits: 04
Max. Marks: 80
Time: 3 Hrs.

Note:-Examiner will set 09 questions and the candidates will be required to attempt 05 questions in all. Out of 09 questions one question will be compulsory containing 08 short answer type questions covering the entire syllabus. Further, examiner will set 02 questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

Section-A

Theories of origin of earth and a brief review of knowledge about the solar system. The earth in relation to other planets; major surface features of the earth. Geochemical evolution of the earth. Rheological behavior of crust and upper mantle.

Section-B

The earth's interior; the nature of the crust-mantle boundary, low velocity zone in the upper mantle, the chemical composition and mineralogy of the earth's crust, mantle and core, evidence from experimental petrology & study of meteorites.

Section-C

Thermal evolution and state of the earth. Continental and oceanic heat flow. Convection in mantle. Earthquakes, global seismicity, Density distribution, Density vs. depth profile, earth's internal structures derived from seismology, continental drift, earth's magnetic field, origin of geomagnetic fields, palaeomagnetism, polar wandering, sea-floor spreading.

Section-D

Major features of the earth's gravitational field and their relationships with tectonic processes in crust and upper mantle; geochronology: radiometric dating and its significance. plate tectonics, triple junctions, hot spots & plumes.

Books Recommended:

1. The Solid Earth Cambridge University Press, New York, C.M.R. Fowler.
2. Understanding the Earth: I.G. Guass, P.S. Smith and R.G.L. Wilson
3. The Dynamic earth- A textbook in Geosciences: P.J. Wyllie
4. Physics and Geology: J.J. Jacobs, R.D. Russel and J.T. Killson
5. Fundamental of Geodynamics, A.E. Schieddeggan.
6. Aspects of tectonics-K.S. Validya.
7. The Inaccessible Earth, G.C.Brown and A.E. Mussett.
8. Understanding the Earth:G.Brownn,C.Hawkesworth and C.Wilson
9. Earth, Frank Press, R.Siever
10. Plate Tectonics & Crustal Evolution, K.C. Condie.

M.Sc. Geology (1st Semester)**Paper Code: 17GEO21CL1****Practical based on 17GEO21C1****8hrs/week**

Max. Marks: 100

Time: 4 Hours

Credit: 4

List of Practicals:

- Megascopic study of important invertebrate, vertebrate and plant fossils;
- Microscopic study of important invertebrate and vertebrate fossils and palynomorphs.
- Study of important stratigraphic rocks in relation to Geological time and mineral deposits.

NOTE:- The distribution of Marks is given below:**Practical Exam- 80****Viva-Voce- 10****File Record-10**

M.Sc . Geology (1st Semester)**Paper Code: 17GE021CL2****Practical based on 17GE021C2 & 17GE021C3****8Hrs/week**

Max. Marks: 100

Time: 4 Hours

Credit: 4

List of Practicals:

- Megascopic study of important earth materials, including loose soils, sediments, minerals and ore minerals in hand specimen.
- Study of large scale tectonic feature of the earth. Active and passive volcanoes in the world and mapping of earthquake zone in India
- Study of tectonic division of the Himalaya and internal structure of the earth. Geomorphology through toposheet. Study of climate zone in India.
- Model of interior of the Earth, pie Charts for chemical composition of Earths' crust, bulk Earth and Mantle. Sketch for density vs depth profile.
- Geochronology related Problems: Related to U-Pb, Sm-Nd and K-Ar etc.

NOTE:- The distribution of Marks is given below:**Practical Exam- 80****Viva-Voce- 10****File Record-10**

M.Sc . Geology (1st Semester)**Paper Code- 17GE021C4****Geological Field Training-I****Max. Marks: 100****Credit: 4****Field Work:**

- Study of toposheet and geological maps
- Determination of location on maps
- Measurement of dip and strike of planar surfaces
- Measurement of lineation
- Measurement of stratigraphic columns
- Geological mapping
- Plotting and analysis of field data and preparation of field training report.

Note:

- The duration of the training will be two weeks
- The distribution of marks is given below:
Evaluation of field work- 40
Evaluation of Field Training Report- 40
Viva voce- 20
- The field training report will be evaluated by internal as well as external examiners.

M.Sc. Geology (2nd Semester)

Paper Code: 17GEO22C1

Mineralogy, Instrumentation and Analytical Techniques

4 hrs. / Week

Credits: 04

Max. Marks: 80

Time: 3 Hrs.

Note:-Examiner will set 09 questions and the candidates will be required to attempt 05 questions in all. Out of 09 questions one question will be compulsory containing 08 short answer type questions covering the entire syllabus. Further, examiner will set 02 questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

Section-A

Mineralogy: Definition of Mineral, Different groups of minerals: Silicates, carbonates, sulphates, oxides and other mineral groups;

Crystallography: definitions, elements of symmetry, Miller, Space lattice. Morphological classification of crystals into systems and symmetry classes (Holoheral Classes). Twinning in crystals.

Section-B

Introduction: uses of analytical techniques, Evolution with technological development, Importance of sophisticated instrument and accurate analysis; Modal count techniques.

Sampling in Geoscience, Sample preparation: Preparation thin section and polished section making - Cutting, grinding and polishing; Powder sample preparation crushing & pulverizing; Solution sample preparation.

Section-C

Techniques of Microfossils slide preparation. Extraction methods for Organic walled and In-Organic walled Microfossils.

Engineering Geology techniques: Strength determination of geological material, Rock Quality Designation (RQD), Basic concepts of Geo-Physical techniques.

Section-D

Sedimentology techniques: Sieves & sieve shaking; Sample etching & staining, heavy minerals & clay minerals methods, size & shape of sediments studies;

Geochemistry techniques: Flame photometer, UV spectrophotometer, Atomic Absorption Spectrophotometry; ICP-Mass spectrometry; X-ray fluorescence spectrometry; Electron microscopy and electron-probe microanalysis.

Books Recommended:

1. The rock forming minerals. Deer,W.A., Howie,R.A. and Zussman,J. Longman.
2. Manual of Mineralogy. Klein,C. and Hurlbut,Jr.C.S. John Wiley.
3. Introduction to Mineral Sciences. Putnis,A. Cambridge University press.
4. Mineralogical phase equilibria and Pressure-Temperature-Time paths. Spear,F.S. Mineralogical Society of America Publ., 1993.
5. Optical Mineralogy. Phillips,W.R. and Griffen,D.T. CBS publishers.
6. Laboratory handbook of petrographic techniques. Hutchinson,C.S. John Wiley.
7. Dana's text book of Mineralogy. Ford,W.E. Wiley Eastern.
8. Rutley's Elements of Mineralogy. Read,H.H. CBS publishers.
9. Mineralogy. Berry, Mason and Dictrich. CBS publishers.
10. Optical Mineralogy. Kerr,P.F.
11. Text book of Mineralogy. Winchell,A.N.
12. Optical Mineralogy. Wahlstrom,E.E.
13. Elements of Optical Mineralogy I & II. Winchell,A.N.
14. Practical Manual of crystal optics. Babu,S.K. and Sinha,D.K. CBS Publishers.
15. Mineral optics. Phillips,R.W. Freeman & Company, USA.

M.Sc. Geology (2nd Semester)

Paper Code: 17GEO22C2 Structural Geology

4 hrs. / Week

Credits: 04

Max. Marks: 80

Time: 3 Hrs.

Note:-Examiner will set 09 questions and the candidates will be required to attempt 05 questions in all. Out of 09 questions one question will be compulsory containing 08 short answer type questions covering the entire syllabus. Further, examiner will set 02 questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

Section-A

Mechanical principles and properties of rocks and their controlling factors. Theory of rock failure. Concept of stress and strain and their relationships of elastic, plastic and viscous materials. Strain markers in naturally deformed rocks. Behavior of minerals and rocks under deformation conditions.

Section-B

Fold: Mechanics of folding and buckling. Fractures and Joints: Their nomenclature, age relationship, origin and significance, causes and dynamics of faulting, strike-slip faults, normal faults, overthrust and nappe.

Section-C

Concept of petrofabrics and symmetry: Objective, field and laboratory techniques, Types of fabrics. Time relationship between crystallisation and deformation.

Section-D

Planar and Linear fabrics in deformed rocks, their origin and significance. Structural behavior of diapirs and salt domes.

Books Recommended:

1. Folding and fracturing of rocks. McGRAW Hill: Ramsay, J.G. (1967).
2. An outline of Structural Geology, John Wiley : Hobbs, B.E., Means, W.D. and Williams, P.F. (1976)
3. Structural Geology of rocks and region. John Wiley : Davis, G.R. (1984)..
4. Modern Structural Geology. Vol I & II. Academic Press : Ramsay J.G. and Hubber, M.I. (1987).
5. Analysis of geological structures. Cambridge Univ. Press : Price, N.J. and Cosgrove, J.W. (1990).
6. Structural Geology fundamentals of modern developments. Pregamon Press : Ghosh, S.K. (1995).
7. Geological structures and Moving plates : Park, R.G.

M.Sc. Geology (2nd Semester)

Paper Code: 17GEO22C3 Palaeobiology and Micropalaeontology

4 hrs. / Week
Credits: 04
Max. Marks: 80
Time: 3 Hrs.

Note:-Examiner will set 09 questions and the candidates will be required to attempt 05 questions in all. Out of 09 questions one question will be compulsory containing 08 short answer type questions covering the entire syllabus. Further, examiner will set 02 questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

Section-A

Species concept, Mechanisms of evolution, theories of evolution, origin of life, origin of Metazoa. Major events in the history of life, bathymetric distribution of life, biostratigraphic zones. Evolution of Horse, Elephant and Man; Gondwana Flora.

Section-B

Functional morphology, evolutionary trends and geological history of Brachiopods, Trilobites, Mollusca, Echinoderms and Graptolites.

Section-C

Micropalaeontology, its definition and scope, surface and sub-surface sampling, processing of samples for preparation of microfossils, Morphology and geological distribution of Foraminifera, Ostracoda, Conodonts, Radiolarians, Silicoflagellates, and Chitinozoans.

Section-D

Study of morphology, ecology and geological history of Charophytes and Phytoplanktons. Morphology of fossil spores, pollen grains and acritarchs. Applications of microfossils and palynofossils in coal and petroleum exploration. Palaeoenvironmental interpretations based on microfossils

Books Recommended:

1. Invertebrate Palaeontology and Evolution. IV Ed. Blackwell : Clarkson, E.N.K. (1998).
2. Palaeontology- The record of life. John Wiley: Stearn, C.W. & Carroll, R.L. (1989).
3. Systematics and the Fossils Record- Documenting Evolutionary Patterns. Blackwell: Smith, A.B. (1994).
4. Bringing Fossils to Life- An introduction to Palaeobiology. McGraw Hill: Prothero, D.R. (1998).
5. Introduction to Marine Micropalaeontology. Elsevier: Haq, B.V. and Boersma, A., (1998).
6. Foraminifera. John Wiley: Haynes, J.R. (1981).
7. Elements of Micropalaeontology. Graham and Trotman : Bignot, G. (1985).
8. Principles of Micropalaeontology (Hfner Publ.) : M.E. Glassner
9. Principles of Zoological Micropalaeontology (Pargamon Publ.) : V. Pokherny
10. Microfossils : Jones
11. Foraminifera : Cushman
12. Ostracoda : Palaecrny
13. Microfossils : Brasier
14. Invertebrate Fossils (Mc Graw Hill) : Moore, Lalicker and Fuscher
15. Principles of Invertebrate Palaeontology : Shrock and Twenoffel
16. An Introduction to the study of plants : J. Walten
17. Essentials of Palynology : P.K.K. Nair
18. Aspects of Palynology : T. Schudy

19. Invertebrate Palaeontology : Swinnerton
20. Treaties on Invertebrate Palaeontology : R.O. Moore (Editor)
21. The Micropalaeontology of Oceans (Cambridge Univ. Press) : D.M. Funnel and W.R. Riede.
22. Invertebrate Palaeontology : Woods, H.
23. Evolution of Vertebrates : Colbert, E.R.
24. Palaeontology : Taylor
25. Vertebrate Palaeontology : Ramer, R.S.
26. Organic Evolution : Lull, R.S.
27. Micropalaeontology : K. Kathal, CBS publication.

M.Sc . Geology (2nd Semester)**Paper Code: 17GEO22CL1****Practical based on 17GEO22C1****8Hrs/week**

Max. Marks: 100

Time: 4 Hours

Credit: 4

List of Practicals:

- Practicals on microfossils slide preparation techniques.
- Rock thin section and slide preparation.
- Sample digestion procedures in geochemistry.
- Exercises on sedimentological techniques.
- Exercises of determination of strength of Earth material.
- Exercises of Ore Reserve Estimation

NOTE:- The distribution of Marks is given below:**Practical Exam- 80****Viva-Voce- 10****File Record-10**

M.Sc . Geology (2nd Semester)**Paper Code: 17GEO22CL2****Practical based on 17GEO22C2 & 17GEO22C3****8hrs/week**

Max. Marks: 100

Time: 4 Hours

Credit: 4

List of Practicals:

- Preparation and interpretation of geological map and sections.
- Structural problems concerning economic mineral deposits.
- Recording and plotting of field data.
- Plotting and interpretation of petro-fabric data and resultant diagrams.
- Study of large-scale tectonic features of the earth.
- Processing of samples, picking and mounting of fauna.
- Preparation of oriented sections.
- Study of invertebrate and vertebrate fossils of important groups.
- Microscopic study of Foraminifera, Ostracoda, fossil spores and pollen grains and phytoplanktons of different periods.

NOTE:- The distribution of Marks will be as prescribed below:**Practical Exam- 80****Viva-Voce- 10****File Record-10**

M.Sc. Geology (2nd Semester)

Paper Code: 17GEO22D1 Environmental Geology

4 hrs. / Week
Credits: 04
Max. Marks: 80
Time: 3 Hrs.

Note:-Examiner will set 09 questions and the candidates will be required to attempt 05 questions in all. Out of 09 questions one question will be compulsory containing 08 short answer type questions covering the entire syllabus. Further, examiner will set 02 questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

Section-A

Components of environment, ecology and ecosystem. Interactions between atmosphere, hydrosphere, lithosphere, biosphere and man. Principles of environmental geology, ethics of conservation; food chain link. Atmosphere and increasing trend of CO₂ and other green-house gases. Fossil fuel burning, ozone layer and global warming. Smog pollution and acid rains, causes and remedies, Other causes of pollutions.

Section-B

Hydrologic cycle and earths' water balance, pollution of surface and sub-surface water. Water quality criteria for domestic and industrial uses; water quality degradation due to use of fertilizers and pesticides. Hydrogeologic considerations for liquid waste disposal. Hydrologic implications of solid waste disposals. Waste (solid, liquid, gases) management and control.

Section-C

Natural resources of lithosphere, land, soil and minerals and their depletion. Land degradation due to natural hazards. Land conservation and land use planning. Watershed management. Impact of irrigation – water logging and soil degradation. Energy minerals and their conservation; nonconventional sources of energy.

Section-D

Types of micro-organisms, role of sulfur, nitrogen and iron bacteria in environment. Biogeochemistry of iron, manganese and sulfur. Marine pollution- causes and controls. Environmental impact assessment – impact of mining on environment; environmental health and environmental law in India.

Books Recommended:

1. Environmental geology: Lindgren, L.
2. Environmental geology: Keller, E.A.
3. Organic micro-pollutants in the aquatic environment: Angeletti, G.
4. Interaction between natural system and man environmental geoscience: Strahler, A.N.
5. A text book of environmental chemistry and pollution control: Dara, S.S
6. Water pollution: Tripathi, A.K. and Panday, S.N.

M.Sc. Geology (2nd Semester)

Paper Code: 17GEO22D2 Fuel Geology

4 hrs. / Week
Credits: 04
Max. Marks: 80
Time: 3 Hrs.

Note:-Examiner will set 09 questions and the candidates will be required to attempt 05 questions in all. Out of 09 questions one question will be compulsory containing 08 short answer type questions covering the entire syllabus. Further, examiner will set 02 questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

Section-A

Definition of coal and sapropel, process of coalification – Rank and grades of coal; chemical characterization – proximate and ultimate analyses; lithotypes, micro-lithotypes and macerals of coal; Technological properties of coal, coking, gasification and hydrogenation.

Section-B

Coal forming epochs in geological past; present day peat bogs and swamps; geological and geographical distribution of coal deposits in India; Important Gondwana coal fields and Tertiary lignite deposits – their salient characteristics, origin and tectonic controls on deposition of Gondwana coals of India.

Section-C

Kerogen sediment, its composition and origin; transformation of organic matter, maturation, thermal cracking, metagenesis and ketagenesis; nature of migration of oil and gas; characteristics of reservoir rocks and traps. Major oil and gas fields of India; India's oil and gas reserves – position in the world and future prospects.

Section-D

Radioactivity and nuclear energy; important atomic minerals – their mode of occurrence and associations; U and Th deposits of India, production, reserves and future scenario. Nuclear power production and its potential in India. Peaceful uses of nuclear energy and nuclear environmental hazards.

Books Recommended:

1. Organic Petrology. Gebruder Borntraeger, Stuttgart : Taylor,G.H., Teichmuller,M., Davis,A., Diessel,C.F.K., Littke,R. and Robert,P. (1998).
2. Text book of coal (Indian Context). Tata Book Agency, Varanasi. Chandra,D., Singh,R.M. and Singh,M.P.
3. Coal and Organic Petrology: Singh,M.P.
4. Text book of Coal Petrology. Stach's Text book of coal Petrology : Stach,E., Mackowsky, M.T.H., Taylor,G.H., Chandra,D., Teichmuller,M., and Teichmuller,R. (1982).
5. Introduction to Petroleum Geology. Gulf Publication Houston, Texas: Holson,G.D. and Tiratsoo,E.N. (1985).
6. Petroleum formation and occurrence. Springer-Verlag : Tissot,B.P. and Welte,D.H. (1984).
7. Elements of Petroleum Geology. Academic Press: Selley,R.C. (1998)
8. Radioactivity in Geology, Principles and Applications: Ellis Hoorwool Durrance,E.M. (1986).
9. Uranium ore deposits. Springer Verlag: Dahlkamp,F.J.(1993)

10. Geochemical prospecting for Thorium and Uranium deposits. Elsevier : Boyle,R.W. (1982). .
11. Coal Geology and Coal Technology. Blackwell Scientific: Australia.Ward, C.R. (1984).
12. Sedimentology of coal bearing sequence of North America. Rahmani,R.A. and Flores,R.M. 1984, Blackwell Scientific, Australia.
13. Coal Industry in India, Kumarmangalam,S.M. 1973, Oxford and IBH.
14. Introduction to the Geology of Coal and Indian Coal fields. Sharma and Rao.
15. Ore deposits of India. Gokhale and Rao, Thomson Press, Delhi.
16. Distribution of World's Mineral Wealth. Rajagopalswami,K. 1971, Mysore University.
17. Economic mineral resources. Krishnaswami,S.
18. Economic mineral deposits. Bateman,A.M.
19. Geology of Petroleum. Levenson,A.I.
20. Introduction to Petroleum Geology. Hobson,G.D.
21. Petroleum Geology. Chapman,R.E.
22. Basic Petroleum Geology. Peter,K.
23. Petroleum Geology. North,F.K.

M.Sc. Geology (3rd Semester)

Paper Code: 17GEO23C1 Stratigraphy, Palaeography and Palaeoecology 4 hrs. /Week
 Credits: 04
 Max. Marks: 80
 Time: 3 Hrs.

Note:-Examiner will set 09 questions and the candidates will be required to attempt 05 questions in all. Out of 09 questions one question will be compulsory containing 08 short answer type questions covering the entire syllabus. Further, examiner will set 02 questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

Section-A

Controls on the development of stratigraphic records, Geological Time Scale. Lithostratigraphy, correlation and stratigraphic code. Biostratigraphy, Magnetostratigraphy, cyclostratigraphy, event. stratigraphy, pedomatigraphy, seismic stratigraphy and sequence stratigraphy.

Section-B

Completeness/incompleteness of stratigraphic records, Precambrian stratigraphy of India, stratigraphic procedures of correlation of unfossiliferous rocks, Stratigraphy of Palaeozoic formations of India.

Section-C

Stratigraphy of Mesozoic and Cenozoic stratigraphic sequences of India with emphasis on Gondwana sequence, Siwalik Group, Deccan Traps and associated sedimentaries and Indogangetic Alluvial plains.

Section-D

Palaeo-geographic reconstruction of India during Gondwana time and Palaeogene, Neogene Periods. Palaeo-ecological analysis of benthic and planktonic fauna and physico-chemical parameters of environments (Salinity, Oxygen, Water energy, Water Depth etc.). Temporal pattern of communities-evolutionary changes in fauna and flora with environments.

Books Recommended:

1. The Cenozoic Era: Tertiary and Quaternary: C. Pomeroy (1982).
2. Precambrian Geology: The Dynamic Evolution of Continental Crust. Academic Press.: Goodwin, A.M. (1991)
3. Principles of Sedimentology and Stratigraphy, Prentice Hall: Sam Jr. Boggs. (1995).
4. Integrative Stratigraphy: Concepts and Applications. Prentice Hall. : R.L. Brenner and T.R. Mottague (1988).
5. Sedimentary and Evolutionary Cycles. Springer-Verlag.: U. Bayer and A. Seilacher (1985).
6. Vol. I: Palaeozoic; Vol. II: Mesozoic A & B; Vol. III: Cenozoic. Elsevier : M. Moullade and A.E.M. Nairn (1983).
7. Seismic Stratigraphy-Applications to Hydrocarbon Exploration. Amer. Assoc. Petrol. Geol. Publ. : C.E. Payton (1977).
8. Unlocking the Stratigraphic Record. John Wiley, Doyle, P and Bennett, M.R., (1996).
9. Precambrian Geology of India, Oxford Univ. Press, Naqvi, S.M. and Rogers, J.J.W., (1987).
10. A Manual of Geology of India and Burma, Vol. I-IV Govt of India Press
11. Palaeomagnetism-Principles and Applications in Geology, Geophysics and Archaeology, Chapman and Hall, Tarling, D.H. (1983).
12. Seismic Stratigraphy. Internat. Human Resource Development Corp. Boston, Sheriff, R.E. (1980).
13. Introduction to Palaeoecology. McGraw Hill, Ager, D.V. (1980).
14. Principles of Palaeoecology. McGraw Hill, Ager, D.V. (1963).
15. Palaeoecology, Longman, Kennety, P and Ross, C.A. (1983).
16. The Ecology of Fossils: Mckerrow, W.S. (1984).
17. Palaeoecology: Concepts and Application. John Wiley. Dodd, J.R. and Stanton, R.J.

18. Treatise on Marine Ecology & Palaeoecology, Vol. 2 (Palaeoecology) Mem. Soc. America. Ladd, H.S. (1957).
19. Geology of India : D.N. Wadia.
20. Geology of India and Burma : M.S. Krishnan.
21. Manual of Geology of India: Pascoe, Vol. I and II and III
22. Fundamental of Historical Geology and Stratigraphy : Ravinder Kumar.
23. Stratigraphic Geology: M.Gigneux.
24. Historical Geology : Dunbar & Waage
25. The Precambrian, vol. I, II & III : R. Rankoma
26. Vertebrate Palaeontology : A.S. Romar
27. Evolution of Vertebrates: E.H. Colbert.

M.Sc. Geology (3rd Semester)

Paper Code: 17GEO23C2 Igneous and Metamorphic Petrology

4 hrs. / Week

Credits: 04

Max. Marks: 80

Time: 3 Hrs.

Note:-Examiner will set 09 questions and the candidates will be required to attempt 05 questions in all. Out of 09 questions one question will be compulsory containing 08 short answer type questions covering the entire syllabus. Further, examiner will set 02 questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

Section-A

Magma generation and emplacement in the crust, mantle and their relation to plate tectonics. Factors affecting magma and evolution of magma. Phase equilibrium of ternary system: (a) Ab-An-Di system, (b) Fo-An-SiO₂ system (c) Fo-Di-SiO₂ and their relation to magma genesis and crystallisation in the light of modern experimental work.

Section-B

Criteria for classification of the igneous rocks. Variation diagrams. CIPW Norms. Texture, chemical composition, distribution and petrogenesis of major igneous rock types such as granite, pegmatite, granodiorite, rhyolite, syenite, diorite, trachyte, andesite, gabbro, basalt, komatiite, alkaline and monomineralic rocks.

Section-C

ACF, AKF, AFM diagrams. A detailed description of each facies of low-pressures, medium- to high- pressures, very high pressure with special reference to characteristic metamorphic zones and subfacies. Nature of metamorphic reactions and pressure-temperature conditions of metamorphism. Mineral assemblages and application of mineralogical phase rule to metamorphic rocks. Isoreactiongrad, Schreinmakers rule and construction of petrogenetic grids.

Section-D

Metasomatism, Metamorphic differentiation. Anatexis and origin of migmatites, granitisation in the light of experimental studies. Regional metamorphism and paired metamorphic belts in reference to Plate Tectonics. Ultra-high temperature, Ultra-high pressure and ocean floor metamorphism. Study of Charnockite, Khondalites and Gondites. Regional and contact metamorphism of pelitic and impure calcareous rocks.

Books Recommended:

1. Igneous and metamorphic petrology. Wiley publication: Best, M. G. (2002).
2. An Introduction to Igneous and Metamorphic Petrology. Prentice Hall Inc. John D. Winter (2001).
3. Principles of igneous and metamorphic petrology. Cambridge University Press: Philpotts, A.R &Ague, J.J. (2009).
4. Principles of Igneous and Metamorphic Petrology, Prentice Hall: Philpotts, A.R. (1994).
5. Using geochemical data-evaluation, presentation and interpretation. 2nd edition. Longman Scientific & Technical. Rollinson, H.R. (2007).
6. An introduction to metamorphic petrology. ELBS publication. Yardley, B.W. D. (1990)

M.Sc. Geology (3rd Semester)**Paper Code: 17GEO23CL1****Practical based on 17GEO23C1 & 17GEO23C2****8hrs/week**

Max. Marks: 100

Time: 4 Hours

Credit: 4

List of Practicals:

- Study of rocks from different stratigraphic horizons.
- Exercises on stratigraphic classification and correlation. Exercises on interpretation of seismic records. Study of paleogeographic maps of different geological periods
- Study of textures and mineral composition of igneous and metamorphic rocks, their identification and classification.
- CIPW norms, variation diagrams, ACF, AKF, AFM diagrams.
- Study of the Texture, Mineral composition, Mode of occurrence, and Association of metamorphic Rocks. Megascopic and Microscopic Identification of Metamorphic Rocks.
- Graphic construction and interpretation of variation diagrams.

NOTE:- The distribution of Marks will be as below:**Practical Exam- 80****Viva-Voce- 10****File Record-10**

M.Sc. Geology (3rd Semester)

Paper Code: 17GEO23D1 Sedimentology and Geomorphology

4 hrs. / Week

Credits: 04

Max. Marks: 80

Time: 3 Hrs.

Note:-Examiner will set 09 questions and the candidates will be required to attempt 05 questions in all. Out of 09 questions one question will be compulsory containing 08 short answer type questions covering the entire syllabus. Further, examiner will set 02 questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

Section-A

Concept of size, porosity and permeability. Sedimentary structures. Sedimentary environment and facies, Maturity of sediments; Lithification and diagenesis; Classification of clastic sedimentary rocks.

Section-B

Conglomerates, sandstones, arkose, shales, clays and loess. Flysch and molasse. Sedimentological characteristics of fluvial, glacial and aeolian environments. Provenance of sediments, paleocurrent analysis.

Section-C

Methods of study of sedimentary rocks in field and laboratory, size analysis of sediments by pipette method and sieving method, staining technique, X-ray and DTA analysis of clays, Heavy mineral analysis and its significance. Application of sedimentary petrology to science, industry and technology; and paleo-seismological studies of sedimentary basins.

Section-D

Concept of Peniplanation, Karst and coastal landforms. Geomorphology of India: Geomorphical features and zones. Geomorphic indicators of neotectonic movements: Stream channel morphology changes, drainage modifications, fault reactivation. Applied Geomorphology: Application in various fields of earth sciences.

Books Recommended:

1. Sedimentary Rocks: Pettijohn, F.J.
2. Depositional Sedimentary Environments: Reineck and Singh
3. Introduction of Sedimentology: Shelly, R.C.
4. Palaeocurrent and Basin analysis: Pettijohn and Potter
5. Sedimentology : Mclane
6. Applications of Sedimentology. Trask
7. Introduction to Sediment analysis. Rouse, F., Arizona State Univ.
8. Principles of Geomorphology: Thornbury, W.D.
9. Introduction to Sedimentology. Sengupta, S, 1997 Oxford and IBH.
10. A Text Book of Geomorphology. Worcester
11. Fundamental Geomorphology. Rice
12. An Introduction to Physical Geology. Miller, W.D.
13. Earth Surface Processes, Allen, P., 1997
14. Sedimentary Environments, Readings, H.G., 1996
15. Sedimentary Basins, Einsele, G., 1992
16. Principles of Sedimentology and Stratigraphy. Boggs, Sam. Jr., 1995

M.Sc. Geology (3rd Semester)**Paper Code: 17GEO23D2 MINING GEOLOGY****4 hrs. / Week**

Credits: 04

Max. Marks: 80

Time: 3 Hrs.

Note:-Examiner will set 09 questions and the candidates will be required to attempt 05 questions in all. Out of 09 questions one question will be compulsory containing 08 short answer type questions covering the entire syllabus. Further, examiner will set 02 questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

Section-A

Basic concepts of mineral prospecting: Definitions and scopes, Geological indicators of mineral deposits. Elements of Geochemical prospecting, Geobotanical observations during mineral prospecting.

Mineral Exploration: Planning of exploration project, Techniques in mineral exploration: Drilling, sampling, Core logging, geological plans and sections.

Section-B

Introduction to Mining: Historical development, Importance and future scopes, basic understanding of mining process and industry; Principles of Mining Industry, Mining Policy and Legislation.

Methods of Mining: Surface Mining: Mechanical and Aqueous Extraction; Subsurface Mining, concept of Ocean bottom mining. Blasting and types of Explosives.

Section-C

Geological operations in Mining: Preparation of mine plans, bench mapping, underground mine mapping, Modelling of ore body, Role of geologists in mine operations, ore reserve estimation.

Mine Economic appraisals: financial management, Infrastructure development, Resources management.

Section-D

Mine safety measures: Mine support and mechanization, drainage and pumping. Elements of Mineral Dressing & mineral beneficiation, Environmental issues: Nature & remedies, mine waste & their management.

Books Recommended:

1. Mining Engineers hand books. Roberts Peele
2. Mining Geology. Mckinstry, H.E.. Asia publishing house
3. Courses in mining Geology. Arogyaswami, R.P.N., Oxford IBH.
4. Elements of mining. Clark, G.B. John Wiley.

M.Sc. Geology (3rd Semester)**Paper Code: 17GEO23D3 Geotectonics****4 hrs. / Week**
Credits: 04
Max. Marks: 80
Time: 3 Hrs.

Note:-Examiner will set 09 questions and the candidates will be required to attempt 05 questions in all. Out of 09 questions one question will be compulsory containing 08 short answer type questions covering the entire syllabus. Further, examiner will set 02 questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

Section-A

Plate Tectonics (The mosaic of plates, Rates of plate motion, The driving mechanism of plate tectonics; Types of plate boundary: convergent, divergent, Conservative plate margins.

Section-B

Continental drift: Geometric, Palaeontologic, Stratigraphic, Palaeomagnetic and climatic evidences in favour of their drifting, Concept of Geosynclines.

Section-C

Theory of Isostasy, Geomagnetism and Sea floor spreading, Mid-oceanic ridges, island arcs, Deep sea canyons and other structures of sea floor.

Section-D

Major tectonic division of Himalaya, Collision of India with Asia, Evolution of volcanic Island Arc, Indus- suture zone, emergence and evolution of Himalaya, fore-arc and back arc basins.

Books Recommended:

1. Plate Tectonics and Crustal Evolution. K.C. Condie
2. Plate Tectonics and Geomagnetic Reversals. Allen Cox
3. Basic problems in Geotectonics. V.V. Belousov
4. Geology of India. D.N. Wadia
5. Geology of the Himalaya. A. Gansser
6. Aspects of Geotectonics. K.S. Valdiya
7. Understanding the Earth. Gass I.G.

M.Sc. Geology (3rd Semester)**Paper Code: 17GEO23DL1****Practical based on 17GEO23D1, 17GEO23D2, 17GEO23D3****8hrs/week**

Max. Marks: 100

Time: 4 Hours

Credit: 4

List of Practicals:

- Gain size analysis using sieves and its statistical analysis
- Determination of roundness of elastic particles using comparison chart method.
- Statistical analysis of orientation data
- Thin section study of sandstones and limestones
- Recognition of major clay minerals from x-ray diffractograms.
- Exercises on geochemical data interpretation
- Regional exploration data analysis and ore reserve estimation.
- Exercises related to trenching, pitting and drilling data.
- Lithological cross sections from core drilling data
- Study of primary, secondary and biogenic sedimentary structures in hand specimens, in photographic atlases, field photographs and wherever possible on the outcrops.
- Analysis and interpretation of depositional sedimentary environments using actual case histories from the Indian stratigraphic records.
- Megascopic and microscopic study of clastic and chemical sedimentary rock.
- Detailed study of diagenetic features in thin sections. Microscopic study of heavy minerals.
- Exercises on mineralogical and geochemical data plots for environmental interpretations.
- Interpretation of different sedimentological characteristics from size data. Roundness and sphericity analysis. Paleocurrent data interpretation.
- Geomorphological analysis from maps and toposheets evaluation.
- Diagrammatic representation of open cast and underground mining. Methods of mining survey. Exercise on mine sampling and determination of tenor, cut-off grades, and ore reserves.

NOTE:- The distribution of Marks will be as below:**Practical Exam- 80****Viva-Voce- 10****File Record-10**

M.Sc . Geology (3rd Semester)**Paper Code: 17GEO23C4****Geological Field Training****Max. Marks: 100****Credit: 4****Field Work:**

- Identification of mappable rock units and common structural and tectonic settings.
- Hands-on training on GPS, Brunton geological compass in field.
- Observations on planar and linear fabric elements.
- Significance and methods for collection of oriented samples in field.
- Large scale mapping on 1:10.00 and 1:10 scale using GPS, Brunton compass, plane table, telescopic alidade & theodolite.
- Visit to at least any one or more of the following applied geological projects:- Mineral/Petroleum/Coal and lignite/groundwater exploration, drilling, and development projects; visit to engineering geological sites such as dams, tunnels, high ways, rail roads, bridges, power houses; cement, bricks and tiles industries, marble and granite mining, cutting and polishing; coal washeries, coke-oven plants, steel plants, metalliferous mines ore concentration and smelting plants etc

Note:

- The duration of the training will be two weeks
- The distribution of marks is given below:
Evaluation of field work- 40
Evaluation of Field Training Report- 40
Viva voce- 20
- The field training report will be evaluated by internal as well as external examiners.

M.Sc. Geology (4th Semester)**Paper Code: 17GEO24C1 Geochemistry****4 hrs. / Week**

Credits: 04

Max. Marks: 80

Time: 3 Hrs.

Note:-Examiner will set 09 questions and the candidates will be required to attempt 05 questions in all. Out of 09 questions one question will be compulsory containing 08 short answer type questions covering the entire syllabus. Further, examiner will set 02 questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

Section-A

The history of Geochemistry, Cosmic abundances of elements and stability, Composition of planets, Composition of meteorites and bulk composition of the Earth. Geochemical classification of elements. Application of thermodynamics, solutions and mineral equilibria - their significance in Geology. Geochemistry of hydrosphere and biosphere.

Section-B

Principles of ionic substitution in minerals; Concept of distribution coefficient and its uses in geochemical modelling; Physico-chemical factors in sedimentation. Trace elements - factors governing their concentration in sediments and their significance. Geochemical cycle.

Section-C

Radiogenic isotopes: Radiogenic isotopes in geochronology, decay schemes, Whole rock isochrones, Model ages, Mineral isochrones and Dating of minerals (U-Pb zircon, sphene and monazite). Interpretation of geochronologic data - blocking temperatures, whole rock and mineral ages.

Principles and application of Rb-Sr, K-Ar, Sm-Nd methods of dating. Principle methodology and application of Fission Track Dating method. Cosmogenic radionuclides: Production of ¹⁰Be and ²⁶Al in the atmosphere, and their application in dating sediments.

Section-D

Stable isotopes: Stable isotopes of O, C and S. Physical controls of stable isotope fractionation. Oxygen isotopes and oxygen isotope thermometry. Carbon isotopes and biogeochemical evolution. Sulphur isotopes- Distribution of sulphur isotopes in nature. Sulphur isotope fractionation. Applications of sulphur isotopes in understanding the hydrothermal ore deposits. Significance of delta D and delta ¹⁸O in hydrological studies - relative age determination of groundwater reservoirs - effect of mixing and evaporation.

Books Recommended:

1. Thermodynamics of Natural Systems, Cambridge University Press: Anderson, G.M. (2005)
2. Neodymium isotope geochemistry: An introduction. Springer- Verlag New York. De Paolo DJ (1988).
3. Radiogenic Isotope Geology. Cambridge University Press: Dickin, A. P. (1995).
4. Principals of Isotope Geology, 2nd Edition, Wiley New: Faure, G (1986).
5. Principles and Applications of Geochemistry. 2nd Edition Prentice- Hall, New Jersey. Faure, G (1998).
6. Principles and Applications, 3rd Edn. John Wiley & Sons : Faure, G. and Mensing, T. M., Isotopes (2005):
7. Stable isotope geochemistry 3rd edition. Springer- Verlag, Berlin: Hoefs, J (1986)
8. Using geochemical data - evaluation, presentation and interpretation. 2nd Edition. Publisher Longman Scientific & Technical: Hugh Rollinson (2007).
9. Principles of Geochemistry. 3rd Edition, Wiley New York: Mason, B (1986).

10. Essentials of geochemistry, student edition. Jones and Bartlett Publishers: Walther John, V. (2009)
11. Introduction to Igneous and Metamorphic Petrology. Prentice-Hall: Winter, J. D. (2001).

M.Sc. Geology (4th Semester)**Paper Code: 17GEO24C2 Ore Geology and Mineral Economics**

4 hrs. / Week
Credits: 04
Max. Marks: 80
Time: 3 Hrs.

Note:-Examiner will set 09 questions and the candidates will be required to attempt 05 questions in all. Out of 09 questions one question will be compulsory containing 08 short answer type questions covering the entire syllabus. Further, examiner will set 02 questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

Section-A

Introduction: Basic terms and definitions, Historical Background, scope of economic geology, Importance of mineral deposits in national economy.

Ore deposits and ore minerals: structure and texture of ore minerals, morphology of Mineral deposits, lithological and structural controls on mineralization.

Section-B

Ore genesis: stable isotopes and physico- chemical conditions of ore formation; Fluid inclusion studies, Mineralisation associated with – (i) ultramafic, mafic and acidic rocks (ii) greenstone belts (iii) komatiites, anorthosites and kimberlites and (iv) Submarine volcanism, metamorphic and metamorphosed processes responsible for ore mineral genesis. Classification of ore bodies;

Section-C

Endogenic processes of ore formation: Early and late magnetic segregation and injection, immiscible liquid segregation, different types of hydrothermal ore formation, volcanic exhalative process,

Exogenic processes of ore formation: Mechanical accumulation, sedimentary precipitates, residual concentration, oxidation and supergene enrichment

Section-D

Geology and distribution of important economic deposits of India: Bauxite, iron, manganese, copper, lead, zinc, gold, chromites, diamond, coal and petroleum.

Metallogeny and mineral belts: Global distribution of minerals in time and space.

Books Recommended:

1. Economic mineral deposits: Bateman, A.M
2. Geology of India: Day, A.M.
3. Economic mineral deposits: Dorokhin
4. Ore deposits of India: Gokhle, K.V.G.K. and Rao, T.C.
5. Geology of India, Pakistan and Burma, Krishnan, M.S.
6. Applied Geology: Kirsch, Helmut
7. Indian mineral resources: Krishnaswami, S.
8. Geology of mineral deposits: Smirnov, V.I.
9. Ore Petrology: Stanton, R.L.
10. Geology of India: Wadia, D.N.
11. Ore Microscopy and ore petrology: Craig, J.R. and Vaughan, D.J.
12. Principles of economic geology: Emmons
13. Mineral deposits Lindgren, W.
14. Bateman, A.M. and Jensen, M.L., "Economic Mineral Deposits", John Wiley & Sons,
15. Guilbert, J.M. and Charles F.P. Jr., "The Geology of Ore Deposits",
16. Waveland Evans, A.M., "Ore Geology and Industrial Minerals": An Introduction",

M.Sc. Geology (4th Semester)**Paper Code: 17GEO24CL1****Practical based on 17GEO24C1& 17GEO24C2****8hrs/week**

Max. Marks: 100

Time: 4 Hours

Credit: 4

List of Practicals:

1. Locating different important mineral deposits on outline map of India /world.
2. Megascopic study of ore specimens/industrial minerals.
3. Microscopic study of important ore minerals.
4. Preparation of polished ore specimen.
5. Microscopic studies of acidic, basic and ultramafic igneous rocks and their petrogenesis.
6. Locating different important mineral deposits on outline map of India /world.
7. Megascopic study of ore specimens/industrial minerals.
8. Microscopic study of important ore minerals.
9. Preparation of polished ore specimen.
10. Microscopic studies of acidic, basic and ultramafic igneous rocks and their petrogenesis.
11. Chemical analysis of rocks and minerals, digestion techniques, preparation of standards, estimation of major oxide percentages using spectrometric methods. Preparation of calibration curves. Problems based on stable Isotope applications. Problems on effect of mixing and evaporation in groundwater reservoirs.

NOTE:- The distribution of Marks will be as below:**Practical Exam- 80****Viva-Voce- 10****File Record-10**

M.Sc. Geology (4th Semester)**Paper Code: 17GEO24DA1 Geohydrology**

4 hrs. / Week
 Credits: 04
 Max. Marks: 80
 Time: 3 Hrs.

Note:-Examiner will set 09 questions and the candidates will be required to attempt 05 questions in all. Out of 09 questions one question will be compulsory containing 08 short answer type questions covering the entire syllabus. Further, examiner will set 02 questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

Section-A

Hydrology in relation to other sciences, hydrosphere, hydrologic cycle, surface and sub surface distribution of water, origin of ground water, springs, hydrometeorology : precipitation, evaporation. Evapotranspiration, seepage, infiltration and runoff and methods of measurement, chemical quality of ground water, its comparison with ocean and surface water.

Section-B

Hydrological properties of water bearing materials, porosity, void ratio, permeability, transmissivity, storativity, specific yield, specific retention, diffusivity, and field and laboratory methods of determination of permeability. Movement of ground water and aquifer performance tests. Darcy law and its range of validity. Theory of groundwater flow under steady and unsteady conditions: determination of permeability, transmissivity and storativity by discharging well methods.

Section-C

Mode of occurrence of ground water. Classification of rocks with respect to their water bearing characteristics, aquifers, aquicludes, aquitards, classification of aquifers. Photogeological and remote sensing studies for water resources evaluation. Groundwater exploration and management, water balance studies, hydrograph analysis, conjunctive and consumptive use of ground water. Water well drilling, development of wells.

Section-D

Physical properties used for groundwater exploration: groundwater exploration methods: resistivity method, concept of apparent and true resistivity, profiling and sounding, range of resistivities for various rocks and minerals, application of seismic refraction method for groundwater problems.

Books Recommended:

1. A text book of Geomorphology (East West Press), P.G. Worcester
2. Ground water Hydrology (John Wiley and Sons), David K. Todd.
3. Principle of Hydrology, Ward.
4. Hand Book of applied Hydrology, Chow
5. Introduction to groundwater hydrology, Health Trainer
6. Hydrology, O. Meinzer.
7. Hydrogeology (John Wiley and Sons), Davis, S.N., Dewiest. R.J.M.
8. Ground water (McGraw Hill) Toman, C.F.
9. Hydrology. Edition (Yoppen Co. Ltd, Tokyo), Wister, C.P. & Brater, E.F.
10. Geohydrology. (John Wiley and Sons), Dewiest, R.J.M.
11. Ground water (McGraw Hill) , Walton, W.C.
12. Ground water (Wiley Eastern Ltd). H.M. Raghunath
13. Hydrology (Laxmi Publications, Delhi), P.Joya , Remi Reddy
14. Basic Exploration Geophysics. Robinson.

M.Sc. Geology (4th Semester)

Paper Code: 17GEO24DA2 Oceanography and Marine Geology

4 hrs. / Week

Credits: 04

Max. Marks: 80

Time: 3 Hrs.

Note:-Examiner will set 09 questions and the candidates will be required to attempt 05 questions in all. Out of 09 questions one question will be compulsory containing 08 short answer type questions covering the entire syllabus. Further, examiner will set 02 questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

Section-A

Distribution of land, seas and oceans: structure, origin, evolution and age of ocean basins. Geomorphology of ocean floor; continental shelf, continental slope, submarine canyons, ridges, plateaus, fracture zones, sea mounts, abyssal plains, deep sea channels trenches, and coral reefs; their distribution and origin

Section-B

Ocean currents and circulation pattern; turbidity and bottom currents; zones of high plankton productivity; bathymetric section, Fauna in ocean floor sediments, their distribution and climatic and Palaeoclimatic significance. Eustatic changes of sea level, causes and methods of study. Temperature-salinity distribution in oceans and seas

Section-C

The concept of sea floor spreading, evidence of magnetic reversal for sea floor spreading, volcanism and mid oceanic ridge system, Indian Ocean ridge system. Marine sediments, source, transportation, deposition classification and types of sediments, $CaCO_3$ deposition, carbonate compensation depth, pelagic and abyssal plain sediments. Biological factors in the formation of sediments. Continental margins, sedimentation on active and passive margins. Structural feature of World oceans Origin, evolution and physiography of Indian ocean.

Section-D

Introduction and historical aspects of marine geology, geological and geophysical methods for ocean floor exploration, techniques of sampling. Sample collection, Marine mineral resources: Beach placer deposits, phosphorites, metalliferous sediments, sulphate deposits, polymetallic nodules; hydrocarbons in marine sediments. India's marine mineral resources. International sea law.

Books Recommended:

1. Keen, M.J. Marine geology, Elsevier
2. Lal, D. S. Oceanography, Sharada Pustak Mahal
3. Siddhartha, K. Oceanography: A brief Introduction, Kisalaya Publication Pvt. Ltd.
4. Mamoria, Chairperson and Sisodia, M.S. Climatology and Oceanography, SBPD Publication.
5. King, C. Introction to Marine Geology and Geomorphology, Crane Russak.

M.Sc. Geology (4th Semester)

Paper Code: 17GEO24DB1 Engineering Geology

4 hrs. / Week

Credits: 04

Max. Marks: 80

Time: 3 Hrs.

Note:-Examiner will set 09 questions and the candidates will be required to attempt 05 questions in all. Out of 09 questions one question will be compulsory containing 08 short answer type questions covering the entire syllabus. Further, examiner will set 02 questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

Section-A

Mechanics of soil and rocks. Compressive, unconfined compressive and shear strength, modulus of elasticity, poisson's ratio, residual stresses, Bearing strength of foundations. Rock Mass Classification: rock quality design index, rock structure rating, rock mass ratings, rock tunnel quality index. Slope mass ratings.

Section-B

Soil profile, soil classifications and types, Atterberg's limits, porosity, permeability and weathering, swelling and pore pressure of soils, cohesion and friction of soil, Mohr's envelope.

Section-C

Construction materials in practice. Dam: types and their foundations, case histories. Tunnel: classification, method of tunneling and case histories. Effect of earth quakes, landslides, flood, cyclone etc. on engineering structures and preventive/mitigation measures. Investigation and analyses of landslides/slopes.

Section-D

Application of geological and geophysical methods in civil engineering projects. Role of engineering geology in planning, designing and constructions of civil engineering projects: dam, tunnel, rail, road and highways, bridges and building. Watershed management, river training and flood control.

Books Recommended:

1. Engineering Geology. Krynine and Yudd. CBS publishers
2. Soil mechanics. Lambe.T.W. and Whitman,R.
3. A text book of soil mechanics. Bharath Singh and Shansheed Prakash.
4. Soil mechanics. Trytovich,N.
5. Design of small dams. Udall,S.L. and Dominy,F.E.
6. Manual of Engineering Geology. Blyth.

M.Sc. Geology (4th Semester)**Paper Code: 17GEO24DB2 Geoexploration****4 hrs. / Week**

Credits: 04

Max. Marks: 80

Time: 3 Hrs.

Note:-Examiner will set 09 questions and the candidates will be required to attempt 05 questions in all. Out of 09 questions one question will be compulsory containing 08 short answer type questions covering the entire syllabus. Further, examiner will set 02 questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

Section-A

Introduction: Basic definitions, historical development and future opportunities and Complexities, planning a prospecting programme, Overview of various stages in Geo exploration, Basics of geophysical methods in Exploration, Geological prospecting criteria and guides to ore search, GIS and computer software applications in Mineral Exploration.

Section-B

Electrical Methods: Electrical properties of rocks and minerals, a brief outline of various types of electrical methods, quantities measured in electrical methods, Wenner and Schlumberger methods of resistivity profiling and sounding.

Magnetic Method: Magnetic properties of rocks and minerals, determination of rock densities, magnetic prospecting.

Section-C

Seismic prospecting and seismology, elementary principles of reflection and refraction methods, quantities measured in seismic methods, two layered reflection and refraction problem, principles of radioactive methods.

Magnetic Method: Basic principal, quantities measured in gravity, Data interpretation

Section-D

Principles of geochemical and geobotanical prospecting. Geological, geochemical and geobotanical exploration for important metallic and non-metallic deposits with Indian examples. Elementary ideas about methods of drilling, core-logging and ore reserve estimation.

Books Recommended:

- 1 Telford, W.M., Geldart, L.P. and Sheriff, R.E., "Applied Geophysics", Cambridge University Press.
- 2 Kearey, P. Brooks, M. and Hill, I., "An Introduction to Geophysical Exploration:", Blackwell.
- 3 Parasnis, D.S., "Principles of Applied Geophysics", Champan and Hall.
- 4 Dobrin, M.B. and Savit, C.H., "Introduction to Geophysical Prospecting".

M.Sc. Geology (4th Semester)

Paper Code: 17GEO24DB3 Remote Sensing & GIS

4 hrs. / Week

Credits: 04

Max. Marks: 80

Time: 3 Hrs.

Note:-Examiner will set 09 questions and the candidates will be required to attempt 05 questions in all. Out of 09 questions one question will be compulsory containing 08 short answer type questions covering the entire syllabus. Further, examiner will set 02 questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.

Section-A

Introduction: Development of remote sensing technology and its advantages, Aerial photographs: Types of aerial photographs, their characteristics: Scale, Height determination and relief displacement, Stereoscopes and photo-mosaics. Satellite Remote Sensing: Imagery Vs aerial photograph, active and passive sensors, different satellite programmes, Basics of Microwave Remote sensing.

Section-B

Fundamentals of digital image processing: characteristics of remote sensing data, pre - processing, enhancements, classification; Principles of image interpretation and analysis concept of FCC, visual and digital interpretation- Interpretation keys.

Photointerpretation to geology: Image characteristics of geological structures and various rock type, landforms and lineaments; Remote Sensing Applications: natural hazards and disaster mitigation, natural resources management and environmental monitoring.

Section-C

Introduction to GIS Technology: Definition, basic concepts, Historical background, What GIS can do? And future scopes of GIS technology; Components of GIS: Hardware, software and their specifications for GIS.

Section-D

GIS data types. Raster and vector data models. Concept of thematic layers and topology. DEM: digital elevation model, digital terrain model and their applications. Global positioning system and its application in Geology, GIS as multidisciplinary tools and their applications in Earth Sciences.

Books Recommended:

- 1.Remote sensing Geology (Springer – Verlag). R.P.Gupta
- 2.Principles and applications of photogeology (Tata – McGraw Hill). Pandey,S.N.
- 3.Remote sensing in Geology. (John Wiley & sons), B.S.Siegal and A.R.
- 4.Photogeology. (MCGraw Hill), V.C.Miller and C.F.Miller.
- 5.Remote sensing and image interpretation (John Wiley & Sons). T.M.Lillesand and R.W. Kieffer.
- 6.Remote principles and interpretations (W.H. Freeman Company) F.F.Sabbins
- 7.Remote sensing for earth resources. (AEG publications, Hyderabad), D.P.Rao.
- 8.Manual of Remote sensing. (American Society of Photogrammetry).
- 9.Principles of Remote Sensing. (ELBS, London), P,J. Currian
- 10.Advances in Geophysics Vol. 1 and 13 (Academic Press) H.E. Landsberg.
- 11.Hand book/ brochures issued by Geological Survey of India (Airborne Mineral Survey and Exploration Wing), Atomic energy commission (Atomic Minerals Division) and National Geophysical Research Institute.

