w.e.f. session 2020-21

Indira Gandhi University, Meerpur, (Rewari)

Examination Scheme and Syllabus

M.Sc. Geology

Choice Based Credit System

(Semester I to IV)

2020-21

Scheme of Examination

M.Sc. Geology
Choice Based Credit System
w.e.f. Session 2020-21

SEMESTER-I

Paper Code	Paper Name	Internal Marks	External Marks	Max Marks	Credits
GEOL-101	Geosciences-I	20	80	100	4
GEOL-102	Geosciences-II	20	80	100	4
GEOL-103	Mineralogy and Crystallography	20	80	100	4
GE0L-104	Igneous Petrology	20	80	100	4
GEOL-105	Structural Geology	20	80	100	4
GEOL-106	Practical based on GEOL-101 & GEOL-102 & GEOL-103	-	100	100	4
GEOL-107	Practical based on GEOL-104 & 105	-	100	100	4
GEOL-108	Geological Field Training-I	40	60	100	6
	Total	**140**	**660**	**800**	**34**

Note:

- Each theory paper will include 20% marks as internal assessment as per University rules.
- Each practical examination will be of 03 hours.
- Practical marks will include 10% marks for viva-voce and 10% for record files.
- Total Credits = 34

SEMESTER-II

Paper Code	Paper Title	Internal Marks	External Marks	Max Marks	Credits
GEOL-201	Geomorphology and Geotectonics	20	80	100	4
GEOL-202	Paleontology and Stratigraphy	20	80	100	4
GEOL-203	Metamorphic Petrology	20	80	100	4
GE0L-204 Or GEOL-205	Engineering Geology Climatology and Oceanography	20	80	100	4
GEOL-206	Practical based on GEOL-201 & GEOL-202	-	100	100	4
GEOL-207	Practical based on GEOL-203 & GEOL-204/GEOL-205	-	100	100	4
GEOL-OE-208	**To be chosen by students of other departments**	**20**	**80**	**100**	**3**
Foundation Elective	From the pool offered by University	20	80	100	2
	Total	**100**	**600**	**700**	**26**

Note:

- Each theory paper will include 20% marks as internal assessment as per University rules.
- Each practical examination will be of 03 hours.
- Practical marks will include 10% marks for viva-voce and 10% for record files.
- Total Credits = 26

SEMESTER III

Paper code	Paper Title	Internal Marks	External Marks	Max Marks	Credits
GEOL-301	Sedimentology and Fuel Geology	20	80	100	4
GEOL -302	Advanced Paleontology	20	80	100	4
GEOL -303	Ore Geology and Indian Mineral Resources	20	80	100	4
GEOL -304 Or GEOL-305	Mineral Exploration and Mining Geology SUMMER INTERNSHIP (ACADEMIC OR INDUSTRIAL)	20	80	100	4
GEOL -306	Practical based on GEOL-301 & GEOL-302	-	100	100	4
GEOL -307	Practical based on GEOL-303 & GEOL-304/GEOL-305	-	100	100	4
GEOL-308	Geological Field Training-II	40	60	100	6
GEOL-OE-309	**To be chosen by students of other departments**	**20**	**80**	**100**	**3**
OE	From the pool offered by University (Excluding the OEC offered by the Dept. of Geology)	20	80	100	3
	Total	**140**	**660**	**800**	**33**

Note:

- Each theory paper will include 20% marks as internal assessment as per University rules.
- Each practical examination will be of 03 hours.
- Practical marks will include 10% marks for viva-voce and 10% for record files.
- Total Credits = 33

SEMESTER-IV

Paper code	Paper Title	Internal Marks	External Marks	Max Marks	Credits
GEOL-401	Geochemistry	20	80	100	4
GEOL-402	Geohydrology	20	80	100	4
GEOL-403	Stratigraphy and Paleogeography	20	80	100	4
GEOL-404	Geophysical Prospecting and Instrumentation	20	80	100	4
GEOL-405 Or GEOL-406	Environmental Geology Or Remote Sensing & GIS	20	80	100	4
GEOL-407	Practical based on GEOL-401and GEOL-402	-	100	100	4
GEOL-408	Practical based on GEOL-403 & GEOL-405/GEOL-406	-	100	100	4
	Total	**100**	**600**	**700**	**28**

Note:

- Each theory paper will include 20% marks as internal assessment as per University rules.
- Each practical examination will be of 03 hours.
- Practical marks will include 10% marks for viva-voce and 10% for record files.
- Total Credits = 28

INDIRA GANDHI UNIVERSITY, MEERPUR, REWARI

DEPARTMENT: **GEOLOGY**
COURSE: **M.Sc. Geology**
SEMESTER: **1st**
SUBJECT CODE: **GEOL-101**
COURSE TITLE: **GEOSCIENCES-I**
MARKS: **EXTERNAL: 80, INTERNAL: 20**
CREDITS: **4**
EXAM DURATION: **THEORY: 03 HOURS**

OBJECTIVE: OBJECTIVE: The course is intended to provide a holistic approach to study formation of Earth and its relationship with other planets of Solar system. This course includes the study of surficial features which are created by various agencies. The subject will serve as an account of the processes at planet's surface with the integrated approach of tectonic forces and the landforms developed on continent surface or on sea floor.
OUTCOME: Students will learn about origin and evolution of Planets in Solar System. This course will help the learner in the understanding the nature and behavior of Earth material. They can develop an understanding about the geomorphic and sedimentological processes related to fluvial, coastal, aeolian, and glacial regimes. Ocean floor morphology can be understood by explaining depth wise division of it.

Course Contents:

Unit No.	Contents
UNIT-I	Modern theories on the origin of the Earth and other planetary bodies. Kepler's laws of planetary motion, Physical parameters of Sun and Planets, Milankovitch cycles Evolution of Earth and it's atmosphere, Interior of Earth, elements of seismology – body and surface waves and their propagation, Earth's gravity and magnetic fields and its thermal structure, concept of Isostasy,
UNIT-II	Classification of rocks and concept of rock cycle, weathering, erosion, transportation and deposition of Earth's material; weathering products and soils, Soil: profile and types, Erosional transportation and depositional features of: wind, river, glacier and groundwater.
UNIT-III	Concept of Sea floor spreading, continental drift, Plate-tectonics and Wilson Cycle; Volcanoes, Earthquakes – their causes and measurement, Major landforms of Earth-Mountains, Plateaus, Plains and oceanic landforms, physiographic divisions of India, river basins in India
UNIT-IV	Hypsography of the continents and ocean floor –continental shelf, slope, rise and abyssal plains; Residence times of elements in sea water, Biological productivity in the oceans. Structure and composition of the atmosphere, Earth's radiation budget; greenhouse gases and effect. Cloud formation and precipitation processes, atmospheric pollution, ozone depletion

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions, one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further, examiner will set two questions from each unit and candidate will be required to attempt one question from each unit. All questions will be carrying equal marks.

Books Recommended:

1. Introduction to Planetary Science (The Geological Perspective) by Gunter Faure & Teresa M. Mensing
2. Understanding Earth. J. Grotzinger, H. Jordan, F. Press
3. Earth Materials. Kevin Hefferan and John O'Brien
4. Earth as an Evolving Planetary System Kent C. Condie
5. Lowrie, W. "Introduction to Geophysics"
6. Lillie, R.J. "Whole Earth Geophysics"
7. Fundamental Planetary Science. JACK J. LISSAUER
8. Introduction to Geomorphology by Vishwas S.Kale & Avijit Gupta.
9. Principal of Geomorphology by W.D. Thornbury
10. "Understanding the earth", W.H. Freeman & Co. Press, F. and Siever, R.,
11. "Physical Geology", Brooks-Cole. by Moore, J.S. and Wicander, R.,
12. "Essentials of Geology", John Wiley & Sons, by Marshak, S.
13. Lal, D. S. Oceanography, Sharada Pustak Mahal
14. The Solid Earth Cambridge University Press, New York, C.M.R. Fowler.
15. Understanding the Earth: I.G. Guass, P.S. Smith and R.G.L. Wilson
16. The Dynamic earth- A textbook in Geosciences: P.J. Wyllie
17. Physics and Geology: J.J. Jacobs, R.D. Russel and J.T. Killson
18. Fundamental of Geodynamics, A.E. Schieddeggan.
19. Aspects of tectonics-K.S. Validya.
20. The Inaccessible Earth, G.C.Brown and A.E. Mussett.
21. Understanding the Earth:G.Brownn,C.Hawkesworth and C.Wilson

INDIRA GANDHI UNIVERSITY, MEERPUR, REWARI

DEPARTMENT: **GEOLOGY**
COURSE: **M.Sc. Geology**
SEMESTER: **1st**
SUBJECT CODE: **GEOL-102**
COURSE TITLE: **GEOSCIENCES-II**
MARKS: **EXTERNAL: 80, INTERNAL: 20**
CREDITS: **4**
EXAM DURATION: **THEORY: 03 HOURS**

OBJECTIVE: The course is intended to familiarize the students with the different branches of Geology.
OUTCOME: Students will get the knowledge about the basics of Palaeontology, Stratigraphy, Structural Geology, Engineering Geology, Mining and Remote Sensing.

Unit No.	Contents
UNIT-I	Principles of stratigraphy, stratigraphic correlation principles; Geological Time Scale, Methods of age determination in Geo-Sciences, Evolution of life through geological ages; fossils, essential conditions of fossilization;
UNIT-II	Basic concepts and broad classification of groups in Vertebrate and Invertebrate paleontology, Palynology and its applications. Use of microfossils in hydrocarbon exploration. Kerogen types and process of transformation of organic matter Petroleum system: Source rock, migration, reservoir rock and traps.
UNIT-III	Introduction to Structural Geology: Elementary ideas about attitude of a bed; contours, topographic and geological maps, tectonic framework of India; Unconformity: types and significance. Engineering properties of rocks, Rock Mass Classification, types of dams, Tunnels: structure and seepage problem, Landslides: classification, causes and preventative measures.
UNIT-IV	Classification of ore deposits, Elements of mineral exploration and mining, methods of mining (alluvial, opencast and underground); Fundamentals of remote sensing; remote sensing systems; Electromagnetic spectrum; electromagnetic bands in remote sensing. Application of remote sensing in Geosciences.

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions, one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further, examiner will set two questions from each unit and candidate will be required to attempt one question from each unit. All questions will be carrying equal marks.

Books Recommended:

1. Doyle, P. and Bennett, M.R., 1996. *Unlocking the Stratigraphic Record,* John Willey.
2. Dunbar, C.O. and Rodgers, J., 1957. *Principles of Stratigraphy.* John Wiley & Sons.
3. Bayly, B., 1992. *Mechanics in Structural Geology,* Springer.
4. An Introduction to the Study of Fossil Plants by Walton, J.
5. Paleontology Invertebrate", CBS Publications. Woods, H.,
6. Vertebrate Paleontology by Chapman & Hall. Benton,M.J.,
7. Paleontology by John Willey & Sons Colbert, R.L.,
8. Shrock&Twinhofel – Invertebrate Paleontology
9. McGowran, B., "Biostratigraphy: Microfossils & Geological Time", Cambridge University Press.
10. Brassier, "Microfossils"
11. Davis, GH. and Reynolds, S.J., 1996. *Structural Geology of rocks and regions,* John Wiley. and Sons.
12. Ghosh, S.K., 1993. *Structural Geology: Fundamentals, and modern developments,* Pergamon Press.
13. Introduction to Petroleum Geology. Gulf Publication Houston, Texas: Holson,G.D. and
14. Tiratsoo,E.N. (1985).
15. Petroleum formation and occurrence. Springer-Verlag : Tissot,B.P. and Welte,D.H. (1984).
16. Elements of Petroleum Geology. Academic Press: Selley,R.C. (1998)
17. Geology of Petroleum. Leverson, A.I.
18. Introduction to Petroleum Geology. Hobson,G.D.
19. Remote sensing Geology (Springer – Verlag). R.P.Gupta
20. Principles and applications of photogeology (Tata – McGraw Hill). Pandey,S.N.
21. Remote sensing in Geology. (John Wiley & sons), B.S.Siegal and A.R.
22. Photogeology. (MCGraw Hill), V.C.Miller and C.F.Miller.
23. Remote sensing and image interpretation (John Wiley & Sons). T.M.Lillesand and R.W. Kieffer.
24. Remote principles and interpretations (W.H. Freeman Company) F.F.Sabbins
25. Remote sensing for earth resources. (AEG publications, Hyderabad), D.P.Rao
26. Mining Engineers hand books. Roberts Peele
27. Mining Geology. Mckinstry,H.E.. Asia publishing house
28. Courses in mining Geology. Arogyaswami,R.P.N., Oxford IBH.
29. Elements of mining. Clark,G.B. John Wiley.

INDIRA GANDHI UNIVERSITY, MEERPUR, REWARI

DEPARTMENT: **GEOLOGY**
COURSE: **M.Sc. Geology**
SEMESTER: **1st**
UBJECT CODE: **GEOL-103**
COURSE TITLE: **MINERALOGY AND CRYSTALLOGRAPHY**
MARKS: **EXTERNAL:80, INTERNAL: 20**
CREDITS: **4**
EXAM DURATION: **THEORY: 03 HOURS**

OBJECTIVE: To provide knowledge about basics of Mineralogy and Crystallography in Geosciences.
OUTCOME: The students will get to know about fundamentals of crystallography and mineralogy so that they can understand Geosciences.

Course Contents:

Unit No.	Contents
UNIT-I	Mineralogy: Definition of Mineral, Importance of Mineralogy and Uses of Minerals. Physical and Optical properties (double refraction, polarization, pleochroism, sign of elongation, interference figure and optic sign) for identifications of Minerals. Petro-logical Microscope- parts and their functions.
UNIT-II	Crystallography: Crystal and Crystallization during mineral genesis, Crystal Defects and Twinning, Nature of chemical bonding and their effects. Concept of Space Lattice and unit cell, Miller Indices, Crystal forms, elements of symmetry, Concept of point group and holohedral classes, Morphological classification of crystals into systems.
UNIT-III	Chemical Analysis of Minerals, Transformation of minerals – polymorphism, Isomorphism, polytypism. Solid solution and ex-solution. Classification of Minerals. Silicate Structures classification, General characters of common rock forming mineral groups-Silicates, Oxides and Carbonates ,
UNIT-IV	Common minerals of igneous, Sedimentary and metamorphic rocks, physical and optical properties of common minerals of rock-forming minerals groups-Quartz, olivine, garnet, alumina-silicates, pyroxene, amphibole, mica, feldspar and clay minerals.

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions, one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further, examiner will set two questions from each unit and candidate will be required to attempt one question from each unit. All questions will be carrying equal marks.

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.
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.

INDIRA GANDHI UNIVERSITY, MEERPUR, REWARI

DEPARTMENT: **GEOLOGY**
COURSE: **M.Sc. Geology**
SEMESTER: **1st**
SUBJECT CODE: **GEOL-104**
COURSE TITLE: **IGNEOUS PETROLOGY**
MARKS: **EXTERNAL: 80, INTERNAL: 20**
CREDITS: **4**
EXAM DURATION: **THEORY: 03 HOURS**

OBJECTIVE**:** The objective of the study to understand how the final appearance and characteristics of igneous rocks is controlled by chemical and physical properties of magmas and their surroundings.
OUTCOME**:** Study of igneous rocks is a key component of geology curriculum (because these rocks not only abundant throughout the crust of the Earth, but, dominate some crustal and upper mantle environments) that provides understanding of melt generation and crystallization mechanisms, diverse rock types and their link to tectonic settings.

Course Contents:

Unit No.	Contents
UNIT-I	Magma and types of magma, Viscosity, temperature and pressure relationships in magmas, partial melting mechanisms and magma generation, magmatic evolution (differentiation, assimilation, mixing and mingling)
UNIT-II	Binary: albite-anorthite, forsterite-silica and diopside-anorthite and ternary: diopside-forsterite-silica, diopside-forsterite anorthite phase diagrams and relevance to magmatic crystallization, Q-Or-Ab system.
UNIT-III	IUGS classification of plutonic and volcanic rocks, Variation diagrams, petrogenesis of major igneous rocks such as granite, basalts, komatiites and alkaline rocks (carbonatite, kimberlite, lamprophyre and nepheline syenite).
UNIT-IV	Structures and textures of igneous rocks; Mantle plume, hotspot magmatism and large igneous provinces of India. Deccan traps

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine question one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further, examiner will set two questions from each unit and candidate will required to attempt one question from each unit. All questions will carry equal marks.

Books Recommended:

1. Best, M. G. Igneous and Metamorphic Petrology, 2nd Edn., Blackwell, 2003
2. Cox, K. G., Bell, J. D. and Pankhurst, R. J. The Interpretation of Igneous Rocks. Unwin Hyman, 1979
3. Hall, A. Igneous Petrology, 2nd Edn., Longman, 1996
4. McBirney, A. R. Igneous Petrology, 3rd Edn., Jones & Bartlett, 2006
5. Middlemost, E. A. K. Magmas and Magmatic Rocks. Longman, 1985
6. Parfitt, E. and Wilson, L. Fundamentals of Physical Volcanology. Wiley-Blackwell, 2008.
7. 2nd Ed., Winter, J. D. Introduction to Igneous and Metamorphic Petrology. Prentice-Hall India, 2010

INDIRA GANDHI UNIVERSITY, MEERPUR, REWARI

DEPARTMENT: **GEOLOGY**
COURSE: **M.Sc. Geology**
SEMESTER: **1st**
SUBJECT CODE: **GEOL-105**
COURSE TITLE: **STRUCTURAL GEOLOGY**
MARKS: **EXTERNAL: 80, INTERNAL: 20**
CREDITS: **4**
EXAM DURATION: **THEORY: 03 HOURS**

OBJECTIVE**:** Know the classification and mechanism of faults and fractures, the rock-types associated with them. Know the types of foliation and lineation, their origin, and their relationship to folding and fabric.
OUTCOME**:** Successful students in this course be able to demonstrate proficiency in common skills in Structural Geology, including structural features of a region from this interpret geological history of area. Successful students be able to apply this study in various other branch of Geology e.g. Groundwater geology, petroleum geology, engineering geology etc.

Course Contents:

Unit No.	Contents
UNIT-I	Mechanical 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. Types of strain ellipses and ellipsoids, their properties and geological significance. Strain markers in naturally deformed rocks.
UNIT-II	Fold anatomy, classification and mechanism of folding and field evidence of fold. Fractures and Joints: Their nomenclature, age relationship, origin and significance. Causes and dynamics of faulting, strike-slip faults, normal faults, overthrust and nappe and field evidences of faults.
UNIT-III	Effect of confining Pressure, Temperature, Pore-fluid pressure, and strainrate in rocks. Shear Zones: Brittle and ductile. Mylonites and cataclasites-their origin and significance. Structural behavior of diapirs and salt domes. Major tectonic features and associated structures in extensional-, compressional-, and strike-slip-terrenes.
UNIT-IV	Concept of petro-fabrics and symmetry. Foliation and lineation, their origin and significance. L-, L-S-, and S-tectonic fabrics. Use of stereographic and equal area projections. Time relationship between crystallization and deformation.

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine question one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further, examiner will set two questions from each unit and candidate will required to attempt one question from each unit. All questions will carry equal marks.

Books Recommended:

1. Ghosh, S.K. (1993): Structural Geology: Fundamental and Modern Development. Pergamon Press.
2. Grohong, R.H (2006): 3-D Structural Geology, Springer-Berlin-Hydelberg-New York
3. Fossen, H. (2010): Structural Geology, Cambridge University Press
4. Hatcher Jr. R.D. (1990): Structural Geology, Merrill Publishing Company.
5. Leyshon, P. R. And Lisle, R.J (2004): Stereographic projection techniques for geologists and civil engineers, Cambridge University Press
6. Ramsay J.G. and Huber M.I. (2002): The Techniques of modern structural geology, 2nd ed., Vol. 2, Elsevier Science Ltd.
7. Ramsay, J.G. (1967): Folding and fracturing of rocks, McGraw Hill.
8. Ramsay, J.G. and Huber, M.I. (2000): Techniques of Modern Structural Geology, Vol. III (Application of continuum mechanics), Academic Press.
9. Turner, F.J. and Weiss, L.E. (1963): Structural analysis of Metamorphic Tectonites, McGraw Hill.
10. 10.Twiss R.J. and E. M. Moores, 1992. Structural Geology, Freeman.
    11. Park, R.G., 1982. Foundations of Structural Geology (2nd Edition), Blackie (1982).
11. Windley B. (1973): The Evolving continents, John Wiley and Sons, New York.
12. Gokhale, N. W. (2009): A Manual of Problems in Structural Geology, CBS Publications.
13. Bose, N. and Mukherjee, S. (2017): Map Interpretation for Structural Geologists, Elsevier.
14. Passchier, C.W., and R.A.J. Trouw, 1996. Microtectonics, Springer.

INDIRA GANDHI UNIVERSITY, MEERPUR, REWARI

DEPARTMENT:	**GEOLOGY**
COURSE:	**M.Sc. Geology**
SEMESTER:	**1st**
SUBJECT CODE:	**GEOL-106**
COURSE TITLE:	**PRACTICAL BASED ON GEOL-101, GEOL-102 AND GEOL-103**
MARKS:	**EXTERNAL: 100**
CREDITS:	**4**
EXAM DURATION:	**Practical: 03 HOURS**

Course contents:

Lab work based on Geosciences-I

- Study of Internal Structure of Earth with Models.
- Earthquake Zonation map of India.
- Physiographic map of India.
- Distribution of Volcanoes on Globe.

Lab work based on Geosciences-II

- Megascopic study of important invertebrate, vertebrate and plant fossils;
- Microscopic study of important invertebrate and vertebrate fossils and palynomorphs

Lab work based on GEOL-103

- Megascopic study of common rock forming minerals in hand specimen.
- Practice on setting of Petro-logical microscope with use of its parts.
- Optical properties of common minerals under Plan and cross polarized light.
- Identifications of crystal forms on crystalline mineral specimen & Models.
- Practice on basic methods to determine the chemical composition of minerals.

INDIRA GANDHI UNIVERSITY, MEERPUR, REWARI

DEPARTMENT:	**GEOLOGY**
COURSE:	**M.Sc. Geology**
SEMESTER:	**1st**
SUBJECT CODE:	**GEOL-107**
COURSE TITLE:	**PRACTICAL BASED ON GEOL-104 AND GEOL-105**
MARKS:	**EXTERNAL: 100**
CREDITS:	**4**
EXAM DURATION:	**Practical: 03 HOURS**

Course Contents:

Lab work based on GEOL-104

- Study of igneous rocks in hand specimens
- Study of Textures of Igneous Rocks under the petrological microscope
- Norm calculations and application of Geosoftware

Lab work based on GEOL-105

- Preparation and interpretation of Geological maps and sections;
- Structural problems based on orthographic and stereographic projections
- Recording and plotting of the field data
- Study of the hand specimen of deformed structures;
- Practical Strain Analysis
- Structural problems related to borehole data

INDIRA GANDHI UNIVERSITY, MEERPUR, REWARI

GEOL-108 GEOLOGICAL FIELD TRAINING-I					
Duration	**Credit**	**Internal**	**External**	**Total**	**Exam**
7-10 days	**6**	**40**	**60**	**100**	**Report submission and Viva after completion of field training**
OBJECTIVE					
To impart understanding of geological fields and to get familiar with the basic use of geological equipment.					
COURSE OUTCOME					
Students get knowledge about Brunton compass, topographic sheet, geological maps and mapping and their uses in field.					

Course Contents:

- Study of topographic-sheets and geological maps
- Determination of location on maps
- Measurement of dip and strike of planar surfaces
- Understanding of stratigraphic column
- Geological mapping
- Plotting and analysis of field data and preparation of field training report

INDIRA GANDHI UNIVERSITY, MEERPUR, REWARI

DEPARTMENT: **GEOLOGY**
COURSE: **M.Sc. Geology**
SEMESTER: **2nd**
SUBJECT CODE: **GEOL- 201**
COURSE TITLE: **GEOMORPHOLOGY AND GEOTECTONICS**
MARS: **EXTERNAL: 80, INTERNAL: 20**
CREDITS: **4**
EXAM DURATION: **THEORY: 03 HOURS**

OBJECTIVE**:** The course provides an overview of the landforms, land forming processes, and landscape evolution. In particular, it aims to shed light on various land forming processes and how these depend on climate and tectonic regime and time. The course shall further convey an understanding of land forming processes on different temporal and spatial magnitude.
OUTCOME**:** The course will provide an understanding of the conceptual and dynamic aspects of landform development. Students will also learn the relevance of applied aspects of Geomorphology in various fields. Successful students in this course be able to understand evolution of the Great Himalaya and other mountains of the world.

Course Contents:

Unit No.	Contents
UNIT-I	Basic concepts and significance of Geomorphology; Cycle of erosion; Landforms produced by geomorphic agents: Fluvial, Coastal, Glacial and Aeolian landforms; desert type; Neotectonics: Geomorphological indicators, active faults, drainage changes, recurrent seismicity.
UNIT-II	An elementary idea about morphogenesis and morphography; Morphometric analysis; Morphochronology; Geomorphology of India - Peninsular, extra-peninsular and Indo-Gangetic Plains. Application of Geomorphology in Mineral Prospecting, Civil Engineering, Military purposes, Hydrogeology and Environmental studies.
UNIT-III	Introduction to geotectonics; Continental drift, seafloor spreading and convection current hypotheses; Paleomagnetism, polar wandering and reversal of earth's magnetic field; Geomagnetic time scale; Mantle Plume models of plate movements.
UNIT-IV	Principal tectonic feature of the Earth-Precambrian shields, Phanerozoic region, feature of plate tectonic boundaries, nature and types of plate margins; Anatomy of orogenic Belts; Orogeny and Epeirogeny; Geodynamic Evolution of Himalaya.

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions, one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further, examiner will set two questions from each unit and candidate will be required to attempt one question from each unit. All questions will be carrying equal marks.

Books Recommended:

1. Holmes, A. 1992: Holmes Principles of Physical Geology Edited by P. McL. D. Duff. Chapman and Hall, London.
2. Summerfield (2000): - Geomorphology and Global Tectonics
3. Thornbury W. D. 2004: - Principles in Geomorphology
4. Kale V S and Avijit Gupta 2010: Introduction to geomorphology. University Press
5. Bloom, A. L. 2011: Geomorphology: A systematic analysis of Late Cenozoic Landforms 3rd Edition. Rawat Publications
6. Gass I.G. et al 1982: Understanding the Earth. Artemis Press (Pvt) Ltd. U.K.
7. Condie, Kent. C. 1989. Plate Tectonics and Crustal Evolution. 3rd Edition. Butterworth-Heinemann Ltd.
8. Windlley B. 1995: The Evolving Continents. 3rd Edition Wiley-Blackwell.
9. Davies, G.F. 1999: Dynamic Earth: Plates, Plumes and Mantle Convection. Cambridge University Press.
10. 10.Keller, E.A and Pinter, N 2001: Active Tectonics. 2nd Edition. Pearson Publications.
11. Kearey P, Klepeis, K A and Vine, F.J 2009: Global Tectonics 3rd Edition. Wiley-Blackwell.
12. Burbank D W and Anderson R S 2016: Tectonic Geomorphology

INDIRA GANDHI UNIVERSITY, MEERPUR, REWARI

DEPARTMENT: **GEOLOGY**
COURSE: **M.Sc. Geology**
SEMESTER: **2nd**
SUBJECT CODE: **GEOL-202**
COURSE TITLE: **PALEONTOLOGY AND STRATIGRAPHY**
MARKS: **EXTERNAL: 80, INTERNAL: 20**
CREDITS: **4**
EXAM DURATION: **THEORY: 03 HOURS**

OBJECTIVE**:** Paleontology and Stratigraphy are at the core of geological studies. In order to understand the geological history of earth, it is essential to learn about the life, its origin and how it has evolved over the years. In tandem with Stratigraphic studies, the course will give students the understanding of the geological history of the planet.
OUTCOME**:** In tandem with Stratigraphic studies, the course will give students the understanding of the geological history of the planet.

Course Contents:

Unit No.	Contents
UNIT-I	Introduction to Paleontology and its branches. Fossils and Types of Fossils. Modes of preservation and conditions for fossilization. Geological time scale and prehistoric life. Major events in the evolution of life. Bathymetric Distribution of life.
UNIT-II	Paleontology and types. Functional Morphology, evolutionary trends and geological history of: Brachiopods, Trilobites, Corals, Gondwana Flora and Fauna.
UNIT-III	Stratigraphy and principles of Stratigraphy: History and Development. Matching and correlation. Stratigraphic procedures (Surface and Subsurface); Concept of Lithofacies and Biofacies. Stratigraphic nomenclature (Lithostratigraphic, Biostratigraphic and Chronostratigraphic).
UNIT-IV	Stratigraphic Correlation physical and palaeobiologic criteria of corelation. Concepts of Magnetostratigraphy, Chemostratigraphy, Event stratigraphy, Cyclostratigraphy and Sequence stratigraphy; Radioisotopes and measuring geological time.

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions, one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further, examiner will set two questions from each unit and candidate will be required to attempt one question from each unit. All questions will be carrying equal marks.

Books Recommended:

1. Invertebrate Paleontology and Evolution, Blackwell: Clarkson, E. N. K.
2. Paleontology: The record of Life, John Wiley; Stearn, C. W. & Carroll, R. L.
3. Systematics and the Fossils Records-Documenting Evolutionary patterns. Blackwell; Smith, A.B.
4. Bringing fossils to life- An introduction to Paleobiology. McGraw Hill: Prothero, D. R.
5. Elements of Micropaleontology. Graham and Trotman: Bignot, G.
6. Palaeontology (Palaeobiology) Evolution and Animal Distribution. Jain, P. C. & Anantharaman, M. S.
7. Microfossils. Brasier, M.
8. Principles of Sedimentology and Stratigraphy. Boggs, Sam Jr.

INDIRA GANDHI UNIVERSITY, MEERPUR, REWARI

DEPARTMENT: **GEOLOGY**
COURSE: **M.Sc. Geology**
SEMESTER: **2nd**
SUBJECT CODE: **GEOL-203**
COURSE TITLE: **METAMORPHIC PETROLOGY**
MARKS: **EXTERNAL:80, INTERNAL:20**
CREDITS: **4**
EXAM DURATION: **THEORY: 03 HOURS**

OBJECTIVE**:** The solid-state transformations of rocks which hold clue to the past processes which are not possible to reconstruct by other means. This course aims to enable students to identify critical data as well as provide theoretical basis for interpreting this data for past geodynamic processes, especially the orogenic events.
OUTCOME**:** Identifying equilibrium mineral assemblages through textural and mineralogical observations. Plotting the quantitative as well as qualitative mineral and mineral assemblage data to interpret the discontinuous reactions and to infer the nature of continuous reactions.

Course Contents:

Unit No.	Contents
UNIT-I	Metamorphism: Types of metamorphism and physico-chemical controls (pressure, temperature, fluids and bulk rock composition) of metamorphism; metamorphic structures slate, schist and gneiss; metamorphic textures- pre, syn and post tectonic porphyroblasts
UNIT-II	Concept of zones, facies, isograds and facies series, protolith types and characteristic metamorphic minerals, thermodynamic principles of metamorphic reactions
UNIT-III	Construction and interpretation of ACF, AKF and AFM diagrams, Schrienmaker's rule and construction of petrogenetic grid, geothermobarometry; P-T-t paths
UNIT-IV	Regional metamorphism of pelitic, carbonate and mafic rocks; contact metamorphism; granulite, eclogite and migmatite, Metamorphic differentiation and anatexis, metamorphic terrains in relation to plate tectonics, Paired metamorphic belts

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions, one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further, examiner will set two questions from each unit and candidate will be required to attempt one question from each unit. All questions will be carrying equal marks.

Books Recommended:

1. Bucher, K. and Grapes, R., 2010. *Petrogenesis of Metamorphic Rocks,* Springer.
2. Fry, N., 1985. *Field Description of Metamorphic Rocks,* New York, Geological Society of London Handbook Series.
3. Best, M.G., 2003. *Igneous and Metamorphic Petrology,* Blackwell Science. 28
4. 4 Vernon, R.H.,and Clarke G. L. 2008. Principles of Metamorphic Petrology, Cambridge University Press.
5. 5.2nd Ed., Winter, J. D. Introduction to Igneous and Metamorphic Petrology. Prentice-Hall India,2010
6. Yardley, B.W.D., 1997. *An Introduction to Metamorphic Petrology,* Longman Earth Science
7. Stuwe, K. Geodynamics of the Lithosphere. Springer-Verlag, 2007
8. Philopotts, A.R. Principles of Igneous and Metamorphic Petrology, Prentice Hall, 1994

INDIRA GANDHI UNIVERSITY, MEERPUR, REWARI

DEPARTMENT: **GEOLOGY**
COURSE: **M.Sc. Geology**
SEMESTER: **2nd**
SUBJECT CODE: **GEOL-204**
COURSE TITLE: **ENGINEERING GEOLOGY**
MARKS: **EXTERNAL: 80, INTERNAL: 20**
CREDITS: **4**
EXAM DURATION: **THEORY: 03 HOURS**

OBJECTIVE**:** The principle objective of Engineering Geology is to utilize the geological knowledge to design and develop safe structures against odds. The purpose is assuring that the geological factors regarding location, design and construction are recognized and accounted for.
OUTCOME: This will help students to develop an understanding of the geological factors responsible to create a sound structure whether it is a dam, tunnel or bridge. It may ensure that students understand the factors responsible for instability of slope and how to improve slope stability.

Course Contents:

Unit No.	Contents
UNIT-I	Geological structures and discontinuities, engineering properties of rocks, engineering properties of jointed rocks, Rock Mass Classification: rock quality design index, rock structure rating, rock mass ratings, and rock quality index. Slope mass ratings.
UNIT-II	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.
UNIT-III	Rock slope engineering - factors influencing slope stability, factor of safety of a slope, analysis of slope failure, monitoring of slope stability, improving slope stability.
UNIT-IV	Geotechnical investigation for dam site, reservoir site; geotechnical study for road alignment; geotechnical evaluation of tunnel alignment, methods of tunneling, classification of ground for tunneling purposes, various types of support system; geotechnical investigations for bridge foundation and building foundation; Rock burst and bumps.

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine question one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further, examiner will set two questions from each unit and candidate will required to attempt one question from each unit. All questions will carry equal marks.

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.

INDIRA GANDHI UNIVERSITY, MEERPUR, REWARI

DEPARTMENT: **GEOLOGY**
COURSE: **M.Sc. Geology**
SEMESTER: **2nd**
SUBJECT CODE: **GEOL-205**
COURSE TITLE: **CLIMATOLOGY AND OCEANOGRAPHY**
MARKS: **EXTERNAL:80, INTERNAL: 20**
CREDITS: **4**
EXAM DURATION: **THEORY: 03 HOURS**

OBJECTIVE**:** The atmosphere and climate are a critical part of the earth system, and climatic variability and change are central to the issue of current and future global environmental change. The broad objective of the course is to introduce to the students the fundamentals of atmospheric phenomena, global climate systems and climate change.
OUTCOME**:** On successful completion of this course, students should be able to understand the mean global atmospheric circulations and disturbances, world climate systems, climatic variability and change.

Course Contents:

Unit No.	Contents
UNIT-I	Nature and Scope of Climatology, Climatic elements – atmospheric temperature, pressure, moisture: forms of condensation and precipitation, general atmospheric circulations and processes; Earth's radiation balance; cloud formation and precipitation, water balance. Air masses; Jet streams; tropical cyclones.
UNIT-II	Cloud classification, condensation nuclei, growth of cloud drops and ice-crystals, precipitation mechanisms: Bergeron, Findeisen process, coalescence process – Precipitation of warm and mixed clouds, artificial precipitation, hail suppression, fog and cloud – dissipation. Global warming, Impact of Global Warming.
UNIT-III	Indian Summer Monsoon and ENSO and Indian Ocean dipole. Quaternary climates –glacial-interglacial cycles, eustatic changes, proxy indicators of paleoenvironmental/ paleoclimatic changes, - land, ocean and cryosphere (ice core studies).
UNIT-IV	Ocean Circulation, Coriolis Effect and Ekman spiral, convergence, divergence and upwelling; Oceanic sediments: Factors controlling the deposition and distribution of oceanic sediments; Opening and closing of ocean gateways and their effect on circulation and climate during the Cenozoic. Structure, composition and mechanism of the formation of oceanic crust.

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions, one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further, examiner will set two questions from each unit and candidate will be required to attempt one question from each unit. All questions will be carrying equal marks.

Books Recommended:

Climatology-

1. Menon, P.A. (1989), Our Weather, N.B.T., New Delhi.
2. Das, P.K. (1987), Monsoons, National Book Trust, New Delhi.
3. Fein, J.S. and Stephens, P.N. (1987), Monsoons, Wiley, London.
4. Peterson, S. (1969), Introduction to Meteorology, McGraw Hill Book, London.
5. Thompson, R.D. and Perry, A. (ed.) (1997), Applied Climatology: Principles and Practice, Routledge, London.
6. Barry, R.G. and Chorely, R.J., (2004), Atmosphere, Weather and Climate, Methuen, London.
7. Bhutani S., (2000), Our Atmosphere, Kalyanai Publishers, New Delhi.
8. Critchfield, H.J. (1987), Climatology, Prentice Hall, New Delhi. 9. Griffith, J.F. and Driscell, D.M. (1982), Survey of Climatology, Charles Merril, New York.
9. Lal, D.S. (1993), Climatology, Chaitanya Publishing House, Allahabad.
10. Riehl, H. (1968), Introduction to Atmosphere, McGraw Hill, New York.
11. Robinson, P.J. and Sellers, H. (1986), Contemporary Climatology, Longman, London.
12. Trewartha, G.T. (Latest edition) Introduction to Climate, McGraw Hill, New York.

Oceanography-

1. Denny, M. (2008): How the Ocean Works: An introduction to Oceanography, Princeton University Press, New Jersey.
2. Duxbury, C.A and Duxbury, B. (1996): An Introduction to the world's Oceans, 2nd Edition, C. Brown, Iowa.
3. Garrison, T. (1995): Essentials of Oceanography, Wards worth, London.
4. Garrison, T. (2001): Oceanography - An Introduction to Marine Science, Cole Pacific Grove, USA.
5. Gross, M. Grant (1987): Oceanography: A View of the Earth, Prantice - Hall Inc. New Jersy.
6. Kennel, J.P. (1982): Marine Geology, Prentice Hall, New Jersey.
7. Kerhsaw, S. (2004): Oceanography: An Earth Science Perspective, Routledge, London.
8. Sharma, R.C. (1985): The Oceans, Rajesh Publications, New Delhi.
9. Sharma, R.C. and Vatal, V. (1986): Oceanography for Geographers, Chatanaya Publishing, Allahabad..
10. Ummerkutty, A.N.P. (1985): Science of the Oceans and Human Life, NBT, New Delhi. 15. Von, A.W.S. (1962): An Introduction to Physical Oceanography, Addison,

INDIRA GANDHI UNIVERSITY, MEERPUR, REWARI

DEPARTMENT:	**GEOLOGY**
COURSE:	**M.Sc. Geology**
SEMESTER:	**2nd**
SUBJECT CODE:	**GEOL-206**
COURSE TITLE:	**PRACTICAL BASED ON GEOL-201 & GEOL-202**
MARKS:	**EXTERNAL:100**
CREDITS:	**4**
EXAM DURATION:	**PRACTICAL: 03 HOURS**

Course Contents:

Lab work based on GEOL-201

- Reading topographic maps
- Concept of scale Preparation of a topographic profile
- Preparation of longitudinal profile of a river
- Calculating Stream length gradient index
- Preparation of geomorphic map,
- Interpretation of geomorphic processes from the geomorphology of the area
- Study of landforms and interpretation of lithology and structure from aerial photographs and satellite images and models.

Lab work based on GEOL 202

- Study of different Proterozoic supercontinent reconstructions
- Megascopic study of different types of fossils.
- Megascopic study of important invertebrate fossils.
- Plant Flora of Gondwana
- Tectonics map of India

INDIRA GANDHI UNIVERSITY, MEERPUR, REWARI

DEPARTMENT:	**GEOLOGY**
COURSE:	**M.Sc. Geology**
SEMESTER:	**2nd**
SUBJECT CODE:	**GEOL-207**
COURSE TITLE:	**PRACTICAL BASED ON GEOL-203 & GEOL-204/GEOL-205**
MARKS:	**EXTERNAL: 100**
CREDITS:	**4**
EXAM DURATION:	**PRACTICAL: 03 HOURS**

Course Contents:

Lab work based on GEOL-203

- Study of metamorphic rocks in hand specimens
- Thin section study of important metamorphic rocks, Metamorphic textures and processes,
- Representation of pelitic assemblage in AFM diagrams

Lab Work based on GEOL-204

- Exercises on Engineering Geology maps and sections of dam sites, Reservoir sites, Tunnels, Hill slopes, Open pit slopes.
- Determination of physical properties of rocks and soils i.e. plastic limit, liquid limit etc.

Lab Work based on GEOL-205

- Preparation pf Climatic map of India; and Water cycle
- Interpretation of a daily weather map of India (any two): Pre-Monsoon, Monsoon and Post-Monsoon
- Study of topographic features of ocean floor
- Preparation of bathymetry maps
- Determination of physical and textural properties of marine sediments

CHOICE BASED OPEN ELECTIVE

DEPARTMENT OF GEOLOGY

SUBJECT CODE: **GEOL-OE- 208**
SEMESTER: **2nd**
COURSE TITLE: **GEOSCIENCE AND SOCIETY**
MARKS: **EXTERNAL: 80, INTERNAL: 20**
CREDITS: **3**
EXAM DURATION: **THEORY: 03 HOURS**

Course Contents:

Unit No.	Contents
UNIT-I	Introduction to Geo-science and its various branches, Earth and its place in solar system. Origin and structure of Earth. Geological time scale. Origin and evolution of life through the Earth history.
UNIT-II	Elementary idea of rocks their types, rock cycle, minerals and gemstones. Elementary idea of various Earth processes, continental drift and plate tectonics. Orogenic and epeirogenic movements.
UNIT-III	Elementary idea of geological considerations in site evaluation of engineering, construction, mining and other geological works.
UNIT-IV	Environmental changes through the Earth history. Significance of earth resources to mankind and society. Hydrological cycle and water budget of an Earth.

Books Recommended:

1. Press, F. and Siever, R., "Understanding the earth", W.H. Freeman & Co.
2. Jain, P.C. and Anantharaman, M.S. Palaeontology,
3. Tarbuck, Lutgens, Tasa, "An Introduction to Physical Geology" Eleventh Edition, Pearson Publication.
4. Krynine/Judd. Principles of engineering Geology and Goetechnics, Jain Book Agency.
5. Tod David K. Ground water Hydrology. PHI Learning.

INDIRA GANDHI UNIVERSITY, MEERPUR, REWARI

DEPARTMENT: **GEOLOGY**
COURSE: **M.Sc. Geology**
SEMESTER: **3rd**
SUBJECT CODE: **GEOL-301**
COURSE TITLE: **SEDIMENTOLOGY AND FUEL GEOLOGY**
MARKS: **EXTERNAL:80, INTERNAL: 20**
CREDITS: **4**
EXAM DURATION: **THEORY: 03 HOURS**

OBJECTIVE: To understand how the various sedimentary rocks forms in different types of environment, their characteristic and an overview of the various environment and their landforms and study of various sedimentary archive and proxy for the study of pale-climate.
OUTCOME: Sedimentology is the study of sediments, particularly focusing on how it is produced, transported, and deposited.

Course Contents:

Unit No.	Contents
UNIT-I	Sedimentology: definition and scope. Fundamentals of fluids laminar and turbulent flow. Reynolds. Number and Froude number Sedimentary structures (Physical, Chemical, and Biological). Classification of clastic and non-clastic sedimentary rocks. Definition, measurement and interpretation of grain size. Concepts of Sedimentary Environments. Eolian and lacustrine environments;
UNIT-II	Glacial environment; Deltaic and beach barrier island environments; Estuarine, lagoon and tidal environments. Facies definition, Facies association, Walther's law of Facies and Application Heavy mineral and its significance. Provenance and digenesis of sediments. Sedimentary texture. Maturity of sediments.
UNIT-III	Stratum contours and isopach maps. Definition of coal and sapropel, process of coalification – Rank and grades of coal; physical properties of coal, chemical characterization – proximate and ultimate analyses; Lithotypes, microlithotypes and macerals: their physical, chemical and optical properties.
UNIT-IV	Sedimentary basins and their classification. Sedimentary basins of India. Petroliferous basins of India, conventional and unconventional sources of oil and gas in India; Radioactivity and nuclear energy, geological characteristics and genesis of major types of U, Th deposits and their distribution in India.

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions, one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further, examiner will set two questions from each unit and candidate will be required to attempt one question from each unit. All questions will be carrying equal marks.

Books Recommended:

1. Blatt, H., Middleton, G.V. and Murray, R.C. (1980) Origin of Sedimentary Rocks, Prentice-Hall Inc.
2. Collins, J.D. and Thompson, D.B. (1982) Sedimentary Structures, George Allen and Unwin, London.
3. Lindholm, R.C. (1987) A Practical Approach to Sedimentology, Allen and Unwin, London.
4. Miall, A.D. (2000) Principles of Basin Analysis, Springer-Verlag.
5. Pettijohn, F.J. (1975) Sedimentary Rocks (3rd Ed.),
6. Harper and Row Publ., New Delhi. Reading, H.G. (1997) Sedimentary Environments and facies, Blackwell Scientific Publication.
7. Reineck, H.E. and Singh, I.B. (1973) Depositional Sedimentary Environments, Springer-Verlag. Selley, R.C. (2000) Applied Sedimentology, Academic Press.
8. Tucker, M.E. (1981) Sedimentary Petrology: An Introduction, Wiley and Sons, New York.
9. Tucker, M.E. (1990) Carbonate Sedimentolgy, Blackwell Scientific Publication. Hota, R.N. (2011) Practical Approach to Petrology, CBS Publisher and Distributors Pvt Ltd., New Delhi
10. Chandra, D., Singh, R.M., Singh M.P., (2000): Text book of coal (Indian context), Tara Book Agency, Varanasi.
11. Scott, A.C., (1987): Coal and coal bearing strata: Recent Advances, Blackwell Scientifics Publications.
12. Stach, E., Mackowsky, M-Th., Tylor, G.H., Chandra, D., Teichumullelr, L . and Teichumuller, R. (1982): Text book on coal petrology, Gebruder Borntreager Stuttgart.
13. Introduction to Petroleum Geology. Gulf Publication Houston, Texas: Holson,G.D. and
14. Tiratsoo,E.N. (1985).
15. Petroleum formation and occurrence. Springer-Verlag : Tissot,B.P. and Welte,D.H. (1984).

INDIRA GANDHI UNIVERSITY, MEERPUR, REWARI

DEPARTMENT: **GEOLOGY**
COURSE: **M.Sc. Geology**
SEMESTER: **3rd**
SUBJECT CODE: **GEOL-302**
COURSE TITLE: **ADVANCED PALEONTOLOGY**
MARKS: **EXTERNAL:80, INTERNAL: 20**
CREDITS: **4**
EXAM DURATION: **THEORY: 03 HOURS**

OBJECTIVE: Paleontology, the study of old life makes a central part of geological and applied geological studies. In order to understand the geological history of earth, it is essential to learn about the life, its origin and how it has evolved over the years.
OUTCOME: In this course we will understand in depth about different life forms that evolved over the years on earth.

Course Contents:

Unit No.	Contents
UNIT-I	Species concept and theories of evolution of life, Pre-cambrian fossil record, Functional Morphology, evolutionary trends and geological history of pelecypods and gastropods, Cephalopods, Graptolites, Echinoderms
UNIT-II	Vertebrate paleontology and evolution through ages. Evolution history of reptiles and mammals (Horses, Elephants and Man) Siwalik vertebrate fauna; Paleontological perspective: Use of paleontological data in a) Stratigraphy b) Palaeoecology and evolution;
UNIT-III	Micropaleontology-Definition and scope. Morphology and geological distribution of: foraminifers, Ostrocods, Conodonts, Radiolarians and Silicoflagelletas
UNIT-IV	Morphology and geological history of Phytoplanktons and dinoflogellates, Acritarchs, chitinozonas Morphology of fossil spores and pollen grains. Application of microfossils and palynofossils in stratigraphy and hydrocabron exploration.

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions, one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further, examiner will set two questions from each unit and candidate will be required to attempt one question from each unit. All questions will be carrying equal marks.

Books Recommended:

1. Invertebrate Paleontology and Evolution, Blackwell: Clarkson, E. N. K.
2. Paleontology: The record of Life, John Wiley; Stearn, C. W. & Carroll, R. L.
3. Systematics and the Fossils Records-Documenting Evolutionary patterns. Blackwell; Smith, A.B.
4. Bringing fossils to life- An introduction to Paleobiology. McGraw Hill: Prothero, D. R.
5. Elements of Micropaleontology. Graham and Trotman: Bignot, G. Palaeontology (Palaeobiology) Evolution and Animal Distribution. Jain, P. C. & Anantharaman, M. S.
6. Microfossils. Brasier, M.

INDIRA GANDHI UNIVERSITY, MEERPUR, REWARI

DEPARTMENT: **GEOLOGY**
COURSE: **M.Sc. Geology**
SEMESTER: **3rd**
SUBJECT CODE: **GEOL-303**
COURSE TITLE: **ORE GEOLOGY AND INDIAN MINERAL RESOURCES**
MARKS: **EXTERNAL:80, INTERNAL: 20**
CREDITS: **4**
EXAM DURATION: **THEORY: 03 HOURS**

OBJECTIVE: To impart basic understanding of different types of mineral deposit and processes of their formation.
OUTCOME: The students will gain knowledge regarding ore deposits, their genesis and mineral economics.

Course Contents:

Unit No.	Contents
UNIT-I	concept of ore and gangue, Elementary aspects of mineral economics. Physico-chemical conditions of ore formation, lithological and structural controls on mineralization, The nature and morphology of the principal types of ore deposit, Classification of ore deposits; Importance of mineral deposits in national economy. Sustainable uses of mineral resources.
UNIT-II	Endogenic processes of ore formation: magmatic ore deposites, volcanic exhalative process, Exogenic processes of ore formation: Mechanical accumulation, sedimentary precipitates, residual concentration, oxidation and supergene enrichment.
UNIT-III	Geology and distribution of important economic deposits of India: Bauxite, iron, manganese, copper, lead, zinc, gold, chromites, diamond, coal, petroleum and nuclear fuel deposits. Metallogeny and its relation to Tectonics and crustal evolution, Global distribution of minerals in time and space. Marine mineral resources.
UNIT-IV	Elements of Geochemical prospecting, Geo-botanical observations during mineral prospecting. Geophysical methods- ground and airborne surveys; gravity, magnetic, electrical and seismic methods of mineral exploration, Basic terminology related to mining, history and future scopes, basic understanding of mining process and industry;

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions, one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further, examiner will set two questions from each unit and candidate will be required to attempt one question from each unit. All questions will be carrying equal marks.

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. Fundamental of Historical geology and stratigraphy of India: Ravindera, K.
12. Ore Microscopy and ore petrology: Craig, J.R. and Vaughan, D.J.
13. Principles of economic geology: Emmons
14. Mineral deposits Lindgren, W.
15. Bateman, A.M. and Jensen, M.L., "Economic Mineral Deposits", John Wiley & Sons,
16. Guilbert, J.M. and Charles F.P. Jr., "The Geology of Ore Deposits",
17. Waveland Evans, A.M., "Ore Geology and Industrial Minerals": An Introduction",

INDIRA GANDHI UNIVERSITY, MEERPUR, REWARI

DEPARTMENT: **GEOLOGY**
COURSE: **M.Sc. Geology**
SEMESTER: **3rd**
SUBJECT CODE: **GEOL-304**
COURSE TITLE: **MINERAL EXPLORATION & MINING**
MARKS: **EXTERNAL:80, INTERNAL: 20**
CREDITS: **4**
EXAM DURATION: **THEORY: 03 HOURS**

OBJECTIVE: This course is designed to give an idea about the various types of geological field operations, which are carried out in Mineral Exploration and Mining.
OUTCOME: The students will get knowledge regarding the fundamentals of Mineral Exploration and various mining methods along with mine safety measures and legislations

Course Contents:

Unit No.	Contents
UNIT-I	Basic terminology and definitions. Planning for Prospecting and Exploration Project. Principal steps in the exploration and exploitation of mineral deposits, Geological Exploration concepts. Techniques in mineral exploration: Drilling, Core logging, Modeling of ore body-geological plans and sections.
UNIT-II	Basics of GPR Survey, Remote Sensing & GIS as tool in Mineral Exploration, Geological Sampling Methods, categorization of ore reserves, ore reserve estimation; National Mineral Policy and Legislations;
UNIT-III	Introduction to Mining: Principles of Mining Industry, Mining Operations: Blasting and types of Explosive, Mine support and Mine safety measures, Environmental issues related to mining.
UNIT-IV	Methods of Mining: controlling factors for selection of mining method, Classification of Mining methods, Surface Mining: Mechanical and Aqueous Extraction; Subsurface Mining methods, Mine Mapping- Mapping in Open Cuts & Underground Openings, underground mine mapping, Mine Economic appraisals,: financial management, Resources management, Elements of Mineral Dressing & mineral beneficiation, Role of geologists in mine operations,

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions, one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further, examiner will set two questions from each unit and candidate will be required to attempt one question from each unit. All questions will be carrying equal marks.

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.
5. Waveland Evans, A.M., "Ore Geology and Industrial Minerals": An Introduction",

INDIRA GANDHI UNIVERSITY, MEERPUR, REWARI

DEPARTMENT:	**GEOLOGY**
COURSE:	**M.Sc. Geology**
SEMESTER:	**3rd**
SUBJECT CODE:	**GEOL-305**
COURSE TITLE:	**SUMMER INTERNSHIP (ACADEMIC OR INDUSTRIAL)**
MARKS:	**EXTERNAL: 80 INTERNAL: 20**
CREDITS:	**4**
EXAMINATION**:**	**REPORT SUBMISSION & PRESENTATION**
DURATION:	**45 Days**

OBJECTIVE**:** The objective of introducing this course is about encouraging students to understand the on ground work of geologists. To make them utilize their theoretical knowledge to do some real-life tasks in industries. This course may help them to develop an interest in research.
OUTCOME**:** The understanding of subject increases by visiting research institutes or industries. The students may learn some of the leading software useful in industries and in research. They shall understand the challenges and required skills to be a researcher or to work in an industry. They shall be motivated to embody those skills and understand the kind of challenges they are going to face after they graduate with a master's degree.

INDIRA GANDHI UNIVERSITY, MEERPUR, REWARI

DEPARTMENT:	**GEOLOGY**
COURSE:	**M.Sc. Geology**
SEMESTER:	**3rd**
SUBJECT CODE:	**GEOL-306**
COURSE TITLE:	**Practical Based on 301 & 302**
MARKS:	**100**
CREDITS:	**4**
EXAM DURATION:	**Practical: 03 HOURS**

Course Contents:

Lab work based on Paper- 301

- study of clastic and non-clastic rocks in hand specimens
- Study of sedimentary rocks in thin section
- Detailed study of digenetic features in thin sections
- Preparation of thin section of sedimentary rocks.
- Grain-size Analysis by sieving Method
- Study of assemblages of sedimentary structures in context of their pale environmental significance

Lab work based on Paper-302

- Megascopic study of important invertebrate fossils in detail.
- Study of important vertebrate fossils groups.
- Observation over Siwalik vertebrates.

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DEPARTMENT:	**GEOLOGY**
COURSE:	**M.Sc. Geology**
SEMESTER:	**3rd**
SUBJECT CODE:	**GEOL-307**
COURSE TITLE:	**Practical Based on GEOL-303 & GEOL-304/GEOL-305**
MARKS:	**100**
CREDITS:	**4**
EXAM DURATION:	**Practical: 03 HOURS**

Course Contents:

Lab work based on Paper- 303

- Locating different important mineral deposits on outline map of India /world.
- Megascopic study of ore specimens/industrial minerals.
- Microscopic study of important ore minerals.
- Preparation of polished ore specimen.
- Preparation of Policed Section.
- Parts and functioning of reflected light microscope.

Lab work based on Paper- 304

- Diagrammatic representation of open cast and underground mining.
- Exercise on mine sampling methods
- Core logging
- Ore reserves Estimation
- Geochemical data interpretation in Mineral Exploration
- Ore body delineation.
- Use of mine safety equipment.

INDIRA GANDHI UNIVERSITY, MEERPUR, REWARI

GEOL-308 GEOLOGICAL FIELD TRAINING-II					
Duration	**Credit**	**Internal**	**External**	**Total**	**Exam**
10 days	**6**	**40**	**60**	**100**	**Report submission and Viva after completion of field training**
OBJECTIVE					
To impart understanding of advanced mapping methods and techniques, sampling in field using different tool and instruments.					
COURSE OUTCOME					
Students get knowledge about large scale mapping methods and techniques, sampling in field using different tools and instruments.					

Note: 100 marks to be awarded jointly by the internal and external examiner after conducting viva-voce examination on field training reports.

Course Contents:

- Identification of mappable rock units and common structural and tectonic settings.
- Hands-on training on GPS, Bruton 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 smelling plants etc.

CHOICE BASED OPEN ELECTIVE

DEPARTMENT OF GEOLOGY

SUBJECT CODE: **GEOL-OE- 309**
SEMESTER: **3rd**
COURSE TITLE: **NATURAL DISASTERS**
MARKS: **EXTERNAL: 80, INTERNAL: 20**
CREDITS: **3**
EXAM DURATION: **THEORY: 03 HOURS**

Course Contents:

Unit No.	Contents
UNIT-I	Introduction to hazards: Hazards' classification and distribution, Natural Hazards and their effects, hazard prediction and early warning, role of community and stake holders.
UNIT-II	Earthquakes: classification, distribution, causes and effects. Tsunami: Types, effects, prediction and early warning systems.
UNIT-III	Landslides: classification, distribution, causes, effects and prevention/mitigation of landslides. Volcan ic hazards: Types, distribution, causes and effects of volcanoes and related hazards.
UNIT-IV	Floods: Types and factors leading to floods, flood control/mitigation measures. Cyclones, thunderstorms and lightening, prediction and early warning, droughts and desertification.

INDIRA GANDHI UNIVERSITY, MEERPUR, REWARI

DEPARTMENT: **GEOLOGY**
COURSE: **M.Sc. Applied Geology**
SEMESTER: **4th**
SUBJECT CODE: **GEOL-401**
COURSE TITLE: **GEOCHEMISTRY**
MARKS: **EXTERNAL: 80, INTERNAL: 20**
CREDITS: **4**
EXAM DURATION: **THEORY: 03 HOURS**

OBJECTIVE: To provide knowledge regarding basics and Significance of geochemistry in Geosciences.
OUTCOME: The students will get to know the vast applications of geochemistry in the field of geosciences.

Course Contents:

Unit No	Contents
UNIT-I	Cosmic abundance, meteorites-types and composition, bulk composition of the Earth, Goldschmidt's classification of elements, Chemical composition and characteristics of atmosphere, lithosphere and hydrosphere.
UNIT-II	Ionic substitution, fractionation of elements in minerals/rocks: Partition coefficient and bulk partition coefficient; application of trace elements in petrogenesis; Diffusion, activity - composition relation (Roult's law and Henry's law)
UNIT-III	Half-life and decay equation; Principle and application of K-Ar, Rb-Sr, U-Pb, Sm-Nd dating systems; Monazite chemical dating
UNIT-IV	Stable isotopes geochemistry: Carbon, Oxygen and Sulphur, Applications of Stable isotopes in geology

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions, one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further, examiner will set two questions from each unit and candidate will be required to attempt one question from each unit. All questions will be carrying equal marks.

Books Recommended:

1. Anderson, G.M. (2005) Thermodynamics of Natural Systems, Cambridge University Press
2. De Paolo DJ (1988) Neodymium isotope geochemistry: An introduction. Spriger- Verlag New York.
3. Dickin, A. P. (1995). Radiogenic Isotope Geology. Cambridge University Press,.

4. Faure, G (1986) Principals of Isotope Geology, 2nd Edition, Wiley New
5. Faure, G (1998) Principles and Applications of Geochemistry. 2nd Edition Prentice- Hall, New Jersey
6. Faure, G. and Mensing, T. M., Isotopes (2005): Principles and Applications, 3rd Edn. John Wiley & Sons.
7. Hoefs, J (1986) Stable isotope geochemistry 3rd edition. Spriger- Verlag, Berlin.
8. Hugh Rollinson (2007) Using geochemical data - evaluation, presentation and interpretation. 2nd Edition. Publisher Longman Scientific & Technical
9. Mason, B (1986). Principles of Geochemistry. 3rd Edition, Wiley New York.
10. Walther John, V. (2009) Essentials of geochemistry, student edition. Jones and Bartlett Publishers
11. Winter, J. D. (2001). Introduction to Igneous and Metamorphic Petrology. Prentice-Hall.

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DEPARTMENT: **GEOLOGY**
COURSE: **M.Sc. Geology**
SEMESTER: **4th**
SUBJECT CODE: **GEOL-402**
COURSE TITLE: **GEOHYDROLOGY**
MARKS: **EXTERNAL 80; INTERNAL 20**
CREDITS: **4**
EXAM DURATION: **THEORY: 03 HOURS**

OBJECTIVE: Water is a basic need to support life on the Earth. The course objective is to focus on groundwater, formations and types of aquifers. The course imparts knowledge about drilling which is used as potable water and being exploited by over pumping, with aims to enable students to understand about the attributes, occurrence, movement and exploration of the groundwater resources.
OUTCOME: The students will learn about the water bearing formations, water wells and how to acquire various aquifer parameters by carrying out pumping tests, slug tests etc. The students will learn about the methods of groundwater exploration and quality parameters.

Course Contents:

Unit No.	Contents
UNIT-I	Types of water: meteoric, juvenile, magmatic and sea waters; hydrologic cycle, vertical distribution of water: zone of aeration and zone of saturation; Classification of rocks and formations according to their water-bearing properties. Aquifers and their types. Water table and piezometric surface
UNIT-II	Water bearing properties of rocks and aquifer parameters: porosity, permeability, specific yield, specific retention, hydraulic conductivity, transmissivity, intrinsic permeability, storage coefficient, storativity, specific storage Groundwater flow concepts; Darcy's Law in isotropic and anisotropic media and validity;
UNIT-III	Bernoulli equation; determination of hydraulic conductivity in field and laboratory; methods for constructing shallow wells, drilling wells, well completion; testing wells, pumping test, slug tests for confined and unconfined aquifers; fluctuations in groundwater levels
UNIT-IV	Surface investigation of groundwater- geologic, remote sensing, electrical resistivity, seismic, gravity and magnetic methods; sub-surface investigation of groundwater- test drilling, resistivity logging, spontaneous potential logging, radiation logging. Groundwater quality - physical and chemical properties of water, quality criteria for different uses.

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions, one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further, examiner will set two questions from each unit and candidate will be required to attempt one question from each unit. All questions will be carrying equal marks.

Books Recommended:

1. Davies, S.N. and De-West, R.J.N., 1966. *Hydrogeology*, John Wiley & Sons, New York.
2. Driscoll, F.G., 1988. *Ground Water and Wells*, UOP, Johnson, Div. St. Paul. Min. USA.
3. Fetter, C.W., 1984. *Applied Hydrogeology*, McGraw-Hill Book Co., New York.
4. Fitts, C.R., 2006. *Groundwater Science*, Academic Press.
5. Freeze, R.A. and Cherry, J.A., 1979. *Groundwater*, Englewood Cliffs, New Jersey: Prentice Hall.
6. Karanth K.R., 1987. *Groundwater: Assessment, Development and Management*, Tata McGraw-Hill Pub. Co. Ltd.
7. Raghunath, H.M., 1987. *Ground Water*, Wiley Eastern Ltd., Calcutta.
8. Schward and Zhang, 2003. *Fundamentals of Groundwater*, John Willey and Sons.
9. Todd, D.K., 2004. *Ground Water Hydrology*, John Wiley & Sons, New

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DEPARTMENT: **GEOLOGY**
COURSE: **M.Sc. Geology**
SEMESTER: **4th**
SUBJECT CODE: **GEOL- 403**
COURSE TITLE: **STRATIGRAPHY AND PALAEOGEOGRAPHY**
MARKS: **EXTERNAL:80, INTERNAL:20**
CREDITS: **4**
EXAM DURATION: **THEORY: 03 HOURS**

OBJECTIVE: To provide understanding regarding the hydro-geological properties of water bearing formations and chemical parameters of water.
OUTCOME: The students will get to know the basic concepts of geohydrology, groundwater prospecting and management.

Course Contents:

Unit No.	Contents
UNIT-I	Stratigraphy: Principles and Classification of Stratigraphy– Litho-, Bio-, Chrono-, Magneto stratigraphy. Geological Time Scale. Basic Idea of Sequence stratigraphy Cyclostratigraphy, Pedostratigraphy, Seismic stratigraphy. Correlation: Physical and paleontological correlation method
UNIT-II	Geological evolution of Archean nucleii (Dharwar, Bastar, Singhbhum, Aravalli and Bundelkhand), structure, and economic importance. Eastern Ghats Mobile Belt.
UNIT-III	North Singhbhum Mobile Belt. Proterozoic sedimentary basins (Cuddapah and Vindhyan). Palaeozoic stratigraphy- Paleozoic (Spiti, Kashmir and Kumaon). Gondwana Supergroup. Palaeogeographic reconstruction of Gondwana time, palaeogene and neogene period.
UNIT-IV	Mesozoic (Spiti, Kutch, Narmada Valley and Trichinopoly), Cenozoic (Assam, Bengal basins, Garhwal-Shimla Himalayas); Siwaliks. Boundary problems in Indian stratigraphy. Deccan Traps. Indo-gangetic Alluvial plains.

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions, one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further, examiner will set two questions from each unit and candidate will be required to attempt one question from each unit. All questions will be carrying equal marks.

Books Recommended:

1. M. S. Krishnan (1982), Geology of India and Burma; 6th Ed. CBS Publishers and Distributors (India).
2. Pomerol, C. (1982): The Cenozoic Era? Tertiary and Quaternary, Ellis Harwood Ltd., Halsted Press. Schoch,
3. Wadia, D.N. (1984), Geology of India; 4th edition. Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
4. Naqvi, S.M. and Rogers, J.J.W. (1987): Precambrian Geology of India, Oxford University Press.
5. Robert, M. (1989): Stratigraphy: Principles and Methods, Van Nostrand Reinhold, New York.
6. Roy, R. Lemon (1990): Principles of Stratigraphy; Merrill Publishing Company.
7. Doyle, P. and Bennett. M.R. (1996): Unlocking the Stratigraphic Record, John Wiley and Sons.
8. Ohio Boggs, S. (2001): Principles of Sedimentology and Stratigraphy, Prentice Hall.
9. M. Ramakrishnan and R. Vaidyanadhan (2008): Geology of India (Vol. I and II); Geological Society of India, Bangalore.
10. K. S. Valdiya (2010): The Making of India-Geodynamic Evolution; Macmillan Publishers India Ltd. 15

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DEPARTMENT: **GEOLOGY**
COURSE: **M.Sc. Geology**
SEMESTER: **4th**
SUBJECT CODE: **GEOL-404**
COURSE TITLE: **GEOPHYSICAL PROSPECTING AND INSTRUMENTS**
MARKS: **EXTERNAL:80, INTERNAL:20**
CREDITS: **4**
EXAM DURATION: **THEORY: 03 HOURS**

OBJECTIVE: Course is designed to give the geology students an introductory idea about the Geophysical prospecting, well logging and various types of instrumentation & analytical techniques used to obtain numerous geological data
OUTCOME: Students will be able to operate various instruments for analytical techniques and understand the Geo-scientific data.

Course Contents:

Unit No.	Contents
UNIT-I	Active source Methods in prospecting: **Seismic Surveying**; reflection and refraction methods, travel time curves for flat and inclined interface, 2D Seismic survey, 3D Seismic survey, time lapsed 3D survey, applications of seismic surveying. **Electrical Surveying**: apparent resistivity, different electrode configurations, sounding and profiling, data interpretation and applications. **Electromagnetic Surveying**: Depth of penetration of electromagnetic fields, Airborne electromagnetic surveying, Ground Penetrating Radar (GPR), applications of electromagnetic surveying.
UNIT-II	Passive Source methods in prospecting: **Gravity Surveying**: Basic theory, unit of gravity, geoid, spheroid, gravimeter, corrections and anomalies, applications of gravity surveying. **Magnetic Surveying**: Physics of magnetism, the geomagnetic field, Rock magnetism, magnetometer, applications of magnetic surveying. **Magnetotelluric Surveying**: Theory and prospecting techniques
UNIT-III	**Geophysical borehole logging**: Gamma, SP, Resistivity, Neutron and Sonic logging techniques and applications
UNIT-IV	XRD analysis for mineral structures, Atomic Spectrophotometry; ICP-Mass spectrometry; X-ray fluorescence spectrometry; Electron microscopy and electron-probe microanalysis.

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions, one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further, examiner will set two questions from each unit and candidate will be required to attempt one question from each unit. All questions will be carrying equal marks.

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. Lowrie, W. “Introduction to Geophysics”
4. Lillie, R.J. “Whole Earth Geophysics”
5. Fowler, C.M.R., “Solid Earth Geophysics”
6. Parasnis, D.S., "Principles of Applied Geophysics", Champan and Hall.
7. Dobrin, M.B. and Savit, C.H., "Introduction to Geophysical Prospecting". McGraw-Hall.
8. Serra O., “Fundamentals of well log interpretation”
9. Asquith G. and Krygowski D., “ Basic Well Log Analysis”
10. Rider, M. “The Geological Interpretation of Well Logs”
11. Log Interpretation Principles/ Applications by Schlumberger
12. Pirsson, S.J., “Handbook of Well Log Analysis”
13. Potts, P.J., “A Handbook of Silicate Rock Analysis”

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DEPARTMENT: **GEOLOGY**
COURSE: **M.Sc. Geology**
SEMESTER: **4th**
SUBJECT CODE: **GEOL-405**
COURSE TITLE: **ENVIRONMENTAL GEOLOGY**
MARKS: **EXTERNAL: 80, INTERNAL: 20**
CREDITS: **4**
EXAM DURATION: **THEORY: 03 HOURS**

OBJECTIVE: To provide knowledge regarding basic concepts of environmental geology.
OUTCOME: The students will acquire knowledge regarding our environment and its significance in the field of geology and our society.

Course Contents:

Unit No.	Contents
UNIT-I	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 CO_2 and other greenhouse gases. Fossil fuel burning, ozone layer and global warming. Smog pollution and acid rains, causes and remedies, Other causes of pollutions.
UNIT-II	Hydrologic cycle and earth's 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.
UNIT-III	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.
UNIT-IV	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.

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions, one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further, examiner will set two questions from each unit and candidate will be required to attempt one question from each unit. All questions will be carrying equal marks.

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.

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DEPARTMENT: **GEOLOGY**
COURSE: **M.Sc. Geology**
SEMESTER: **4th**
SUBJECT CODE: **GEOL-406**
COURSE TITLE: **REMOTE SENSING & GIS**
MARKS: **EXTERNAL:80, INTERNAL:20**
CREDITS: **4**
EXAM DURATION: **THEORY: 03 HOURS**

OBJECTIVE: To introduce the principles of Remote Sensing, GIS Technology and its application in the field of Geoscience.
OUTCOME: Acquisition of knowledge regarding basics of remote sensing, GIS and their application in geo-science.

Course Contents:

Unit No.	Contents
UNIT-I	Introduction: Definition and Process, Advantages and limitations, a brief history of Remote Sensing with technological evolution, Electromagnetic Radiation and EM Spectrum, Interaction of radiation with atmosphere and objects with special emphasis on Atmospheric windows. Type of Platform and Sensors. Aerial photography: Types of aerial photographs, Photogrammetry interpretations: Scale, Height determination and relief displacement, fundamentals of Stereoscopic studies;
UNIT-II	Satellite Remote Sensing: concept of sensor's resolutions, Indian Space programme. Land Observation Satellites/Sensors, Basics of Microwave Remote Sensing and its scope for Geological applications. Image Quality: Factor effected the Quality of image, Fundamentals of digital image processing: pre –processing: Geo-matric and Radiometric corrections, enhancements, classification; Principles of image interpretation and Analysis;
UNIT-III	GIS: Basic concept and definitions, functions of GIS; Components of GIS: Hardware, software and their specifications for GIS. GIS data types. Raster and vector data models. Errors in GIS data- their detection and optimization; Concept of thematic layers and topology. Digital terrain model and their applications. Global positioning system and It's applications.
UNIT-IV	Applications of Remote Sensing and GIS technology: Photointerpretation to geology: Image characteristics of geological structures and various rock type, landforms and lineaments; Remote Sensing Applications in Earth Resource Management: natural hazards and disaster mitigation, Mineral Exploration and environmental monitoring. GIS as multidisciplinary tools and their applications in Earth Sciences.

Note: The examiner will set nine questions and the candidates will be required to attempt five questions in all. Out of nine questions, one question will be compulsory containing eight short answer type questions covering the entire syllabus. Further, examiner will set two questions from each unit and candidate will be required to attempt one question from each unit. All questions will be carrying equal marks.

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.

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DEPARTMENT: **GEOLOGY**
COURSE: **M.Sc. Geology**
SEMESTER: **4th**
SUBJECT CODE: **GEOL-407**
COURSE TITLE: **PRACTICAL BASED ON GEOL-401 & GEOL-402**
MARKS: **100**
CREDITS: **4**
EXAMINATION DURATION: **Practical: 03 HOURS**

Course Contents:

Lab work based on Paper- 401

- Techniques of Chemical analysis of rocks and minerals.
- Preparation of standards.
- Problems based on radiometric systems.
- Problems based on fractionation of stable isotopes

Lab work based on Paper-402

- Depth to water level and water table contour map-based exercise.
- Numerical problems related to estimation of permeability in laboratory and field.
- Water chemistry representation by plots and diagrams i.e. Pie, bar, diamond, etc.

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DEPARTMENT:	**GEOLOGY**
COURSE:	**M.Sc. Geology**
SEMESTER:	**4th**
SUBJECT CODE:	**GEOL-408**
COURSE TITLE:	**PRACTICAL BASED ON GEOL-403 & GEOL-405/GEOL-406**
MARKS:	**100**
CREDITS:	**4**
EXAM DURATION:	**Practical: 03 HOURS**

Course Contents:

Lab work based on Paper- 403

- Demarcation of different stratigraphic units of India on Map.
- Chronological sequence of stratigraphic units of an area.
- Practice for Litholog preparation and correlation.

Lab work based on Paper- 405

- Practice on Environmental data collection and interpretation.
- Exercise on Environmental impact assessment

Lab work based on Paper- 406

- Practice for Stereoscopic vision.
- Visual interpretation of remote sensing data.
- Practice on digital image processing
- GPS data collection and integration with GIS.
- Basic practice on GIS Software.
- Maps preparation in GIS.
- Practice on topology and thematic mapping in GIS