

SHAHEED MAHENDRA KARMA VISHWAVIDYALAYA, BASTAR, JAGDALPUR
SESSION 2021-22

M.Sc. GEOLOGY					
2 Year/4 Semester Course					
Under the Faculty of Science					
FIRST SEMESTER					
FIRST SEMESTER	Paper No.	Title of Papers	Marks		Credit
			External	Internal**	
	I	Structural Geology	80	20	4
	II	Mineralogy	80	20	4
	III	Geochemistry & Geodynamics	80	20	4
	IV	Crystallography & crystal optics	80	20	4
	LC-I	Structural Geology & Survey	100	-	3
	LC-II	Crystallography, Mineralogy & Geochemistry, Geodynamics	100	-	3
Total		520	80	22	
SECOND SEMESTER					
SECOND SEMESTER	Paper No.	Title of Papers	Marks		Credit
			External	Internal**	
	I	Igneous Petrology	80	20	4
	II	Metamorphic Petrology	80	20	4
	III	Sedimentology & Tectonics	80	20	4
	IV	Stratigraphic principles and Indian Geology	80	20	4
	LC-I	Petrology and Stratigraphy	150	-	3
	LC-II	Fieldwork	50	-	2
Total		520	80	21	
THIRD SEMESTER					
THIRD SEMESTER	Paper No.	Title of Papers	Marks		Credit
			External	Internal**	
	I	Paleontology	80	20	4
	II	Ore & Fuel Geology	80	20	4
	III	Geomorphology & Remote Sensing	80	20	4
	IV	Mineral Exploration	80	20	4
	LC-I	Ore Geology and Mineral Exploration	100	-	3
	LC-II	Paleontology, Geomorphology and Remote sensing	100	-	3
Total		520	80	22	
FOURTH SEMESTER					
FOURTH SEMESTER	Paper No.	Title of Papers	Marks		Credit
			External	Internal**	
	I	Mining and Engineering Geology	80	20	4
	II	Environmental Geology & Climatology, Oceanography	80	20	4
	III	Hydrogeology	80	20	4
	LC-I	Hydrogeology Engineering Geology and Mining geology	150		3
Total		390	60	15	

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Core Elective Courses (any one)

Course No	Title of Paper	Max Marks			Credits
		Theory	Internal Assmt.	Total	
ME I	Advanced Hydrogeology	80	20	100	4
Lab course ME- I	Advance hydrogeology	50		50	2
ME II	Project Oriented Dissertation	100		100	4
	Script Evaluation and Viva Voce on Project Dissertation	30		50	2
	Total	130		150	6
		Max Marks			Credits
		Theory	Internal Assmt.	Total	
	Grand Total	2160	340	2500	86

Minor Elective:

		Max Marks			Credits
		Theory	Internal Assmt.	Total	
GMnE-1	Disaster Management	80	20	2500	4

**M.Sc. GEOLOGY
SEMESTER - I
PAPER-I
STRUCTURAL GEOLOGY**

UNIT – I

- 1.1. Concept of Line and Plane; Attitude of Plane and a line; Bedding plane; Plunge and trend; Dip and strike and their measurement.
- 1.2. Criteria for determination of Top & Bottom of sedimentary, metamorphic and igneous rocks in a structurally deformed terrain.
- 1.3. Field techniques of lithological and structural mapping.
- 1.4. Unconformity and its type. Onlap. Offlap, Outlier, Inlier and Tectonic Window

UNIT – II

- 2.1 Rock deformation: Stress & strain, their relationship; Factors controlling rock deformation
- 2.2 Properties of elastic, plastic and brittle materials; Progressive deformation.
- 2.3 Strain analysis: types of strain; strain ellipse; strain ellipsoid; geological application of strain theory.
- 2.4 Stress analysis: compressive and shear stress; biaxial and triaxial stress. Mohr's Circle and envelope.

UNIT – III

- 3.1 Fold: Definition; classifications - geometrical and genetic; its types.
- 3.2 Mechanism of Fold formation.
- 3.3 Superimposed fold; outcrop pattern of superimposed structure comprising of two-fold system.
- 3.4 Stereographic Projection: Principles, Schmidt Net. Plotting a line, plane, intersection of plane. **Alpha, Beta and Rose Diagram.*

UNIT – IV

- 4.1 Fault: types and mechanism of faulting; Principal stress orientation for the three main fault types; Relationship between stress and strain ellipsoid.
- 4.2 Joints and its types; their analysis and relationship to major structures.
- 4.3 Petrofabric Analysis: Field and laboratory techniques; Preparation of petrofabric diagrams and their interpretation.
- 4.4 Structure and tectonics of India.

UNIT – V

- 5.1 Cleavage & Schistosity: definition and types.
- 5.2 Mechanism of formation of Cleavage & Schistosity; its relationship with deformation and major structures
- 5.3 Lineation: definition and its types; their mode of development and relation to major structures.
- 5.4 Plutons: Definition & description; Role in progressive deformation.

Books Recommended:

- Ghosh, S.K. (1993): Structural Geology: Fundamental and Modern Development. Pergamon Press.
- Hobbs, B.E., Means, W.D. and Williams, P.F. (1976): An outline of Structural Geology, John Wiley and Sons, New York.

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- Ramsay, J.G. (1967): Folding and fracturing of rocks, McGraw Hill.
- Ramsay, J.G. and Huber, M.I. (1983): Techniques of Modern Structural Geology, Vol. I, Strain Analysis, Academic Press.
- Ramsay, J.G. and Huber, M.I. (1987): Techniques of Modern Structural Geology, Vol. II, Folds and Fractures, Academic Press.
- Ramsay, J.G. and Huber, M.I. (2000): Techniques of Modern Structural Geology, Vol. III (Application of continuum mechanics), Academic Press.
- Turner, F.J. and Weiss, L.E. (1963): Structural analysis of Metamorphic Tectonites, McGraw Hill.
- Windley B. (1973): The Evolving continents, John Wiley and Sons, New York.

**M.SC. GEOLOGY
SEMESTER - I
PAPER-III
GEOCHEMISTRY & GEODYNAMICS**

UNIT – I

- 1.1. Cosmic Abundance of the Elements and Nucleosynthesis. Geology and Chemistry of Moon.
- 1.2. Composition and Classification of Meteorites, Chondrules, Chondrites and Achondrites. Geochemical classification of elements.
- 1.3. Trace, Volatile, Semi volatile, Alkali and Alkaline earth elements.
- 1.4. REE and Y, HFSE elements, Transition & Noble elements.

UNIT – II

- 2.1 Partition coefficient. Compatible and incompatible elements.
- 2.2 Basics of radiogenic isotope geochemistry. Scope of stable isotope geochemistry
- 2.3 Fundamental Thermodynamic Equations. Free energy. Phase equilibrium and Gibb's Phase Rule. Thermodynamics of magmatic Crystallization.
- 2.4 Geochemistry of continental and Oceanic Crust and Island Arcs.

UNIT – III

- 3.1 Growth of continental crust and its mechanism.
- 3.2 Composition of Mantle. Phase transition in the Mantle.
- 3.3 Primitive mantle and mantle differentiation. Geochemical evolution of Mantle Plume. Formation of Core
- 3.4 *Generation of Earths Magnetic Field, Eutrophication*

UNIT – IV

- 4.1 **Origin of Solar System and Theories & Hypothesis related to them*
- 4.2 **Interior of the Earth, Age of the Earth*
- 4.3 **Continental Drift, Plate Tectonics*
- 4.4 **Mid Oceanic ridges, Island Arc, Sea floor spreading*

UNIT -- V

- 5.1 **Geomagnetism, Magnetic Inclination, Magnetic Declination, Apparent polar wandering, Magnetic reversal*
- 5.2 **Earthquake – origin, intensity & magnitude, scale, theories related to earthquake generation, distribution of earthquake with special reference to India*
- 5.3 **Volcano – products, types and their distribution in world with special reference to India*
- 5.4 **Orogeny, Epiorogeny, Isostasy*

Books Recommended:

- Drever, J. I., 1988. *The Geochemistry of Natural Waters*, Prentice Hall, Englewood Cliffs, 437 p.
- Garrels, R. M. and C. L. Christ. 1965. *Solutions, Minerals and Equilibria*. New York: Harper and Row.
- Burns, R. G. 1970. *Mineralogical Applications of Crystal Field Theory*. Cambridge: Cambridge Univ. Press.
- Henderson, P. 1986. *Inorganic geochemistry*. Oxford: Pergamon Press.

**SHAHEED MAHENDRA KARMA VISHWAVIDYALAYA, BASTAR, JAGDALPUR
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- Brownlow, A. H. 1996. *Geochemistry*. New York: Prentice Hall.
- Krauskopf, K. B. and D. K. Bird. 1995. *Introduction to Geochemistry*. New York: McGraw-Hill.
- Bowen, R. 1988. *Isotopes in the Earth Sciences*, Barking (Essex): Elsevier Applied Science Publishers.
- Condie, K. C. 1989. *Plate Tectonics and Crustal Evolution*. Oxford: Pergamon.
- Faure, G., 1986. *Principles of Isotope Geology*, 2nd ed., Wiley & Sons, New York, 589p.
- Drever, J. I., 1988. *The Geochemistry of Natural Waters*, Prentice Hall, Englewood Cliffs, 437 p.
- Garrels, R. M. and C. L. Christ. 1965. *Solutions, Minerals and Equilibria*. New York: Harper and Row.
- White, W. M. *Geochemistry* (Online)

**M.SC. GEOLOGY
SEMESTER – I
PAPER-IV
CRYSTALLOGRAPHY & CRYSTAL OPTICS**

UNIT – I

- 1.1. Crystal growth. Development of ideas of internal structure of crystals.
- 1.2. Space lattices and point systems. X-ray analysis of crystal structure.
- 1.3. Morphology of crystals. Fundamental Laws of Crystal Zones and Zonal Symbols.
- 1.4. Symmetry elements, operations. Classification of Crystals in 32 Classes.

UNIT – II

- 2.1 Symmetry and forms of crystals of isometric, tetragonal and hexagonal systems.
- 2.2 Symmetry and forms of crystals of orthorhombic, monoclinic and triclinic systems.
- 2.3 Goniometry of Crystals. Crystal Projections – Spherical, Gnomonic and Stereographic.
- 2.4 Crystal Aggregates, Twinning, Irregularities & Imperfections in Crystals.

UNIT – III

- 3.1 Principles of transmission and reflection of light from crystals. Classification of minerals according to the interaction of light. Interference.
- 3.2 Refraction and Refractometry. Methods of determination of R.I.
- 3.3 Birefringence in Crystals. Significance and use of plates, wedge and Berek Compensator.
- 3.4 Pleochroism in Crystals.

UNIT-IV

- 4.1 Classification of Crystals into isotropic, Uniaxial and Biaxial minerals.
- 4.2 Isotropic, uniaxial and biaxial indicatrix.
- 4.3 Optical characters of Isotropic and uniaxial minerals.
- 4.4 Optical characters of biaxial minerals.

UNIT - V

- 5.1 Optical Orientation – Extinction angle, Universal stage. Construction & Use.
- 5.2 Dispersion in mineral optic axial angle.
- 5.3 Optical anomalies.
- 5.4 Systematic determination of optical properties of minerals.

Books Recommended:

Phillips, F.C (1971): Introduction to Crystallography, Longman Group Publ.
Dana, E.S. and Ford, W.E. (2002): A textbook of Mineralogy (Reprint).

**M.SC. GEOLOGY
SEMESTER – I
PRACTICALS
LAB COURSE – I**

A) STRUCTURAL GEOLOGY

1. Stereographic projection – problems in angular relationship true dip, apparent dip plunge and rake of the intersection of planes.
2. Study of minor structures in hand specimens.
3. Preparation & Interpretation of geological maps & structure contour maps.
4. Three-point problems geometric solutions for three-point problems & fault problems.

B) Survey

5. Chain tape; Plane table and Prismatic compass survey.
6. Leveling and Tachometric survey.
7. Principles of Theodolite and angle measurement.

LAB COURSE – II

A) Mineralogy and Geochemistry

1. Megascopic study of common rock forming minerals.
2. Microscopic study of common rock forming minerals.
3. Principles and methods of geochemical analysis. Calculation of mineral formulae.
4. Determination of total hardness in water.
5. Spot test for qualitative analysis.

B) Crystallography and Crystal Optics

6. Morphological study of crystal models and twins.
7. Stereographic projection of crystals.
8. Optical determination methods of 1. Refractive Index.
9. Order of Interference colour and birefringence.
10. Interference figure and optic sign.
11. Scheme of pleochroism.
12. An content (Michel Levy's method)
13. Determination of $2V$.

**M.SC. GEOLOGY
SEMESTER – II
PAPER-I
IGNEOUS PETROLOGY**

UNIT- I

- 1.1. Factors affecting magma and its evolution. Composition of primary magma; mantle mineralogy.
- 1.2. Partial melting of mantle – different models. Trace element behavior during partial melting.
- 1.3. Magmatic differentiation processes.
- 1.4. Behavior of major and trace elements during fractional crystallization.

UNIT – II

- 2.1 Concurrent assimilation and fractional crystallization. Magma mixing.
- 2.2 Various criterion for classification of Igneous rocks – **Tabular, IUGS System - QAPF, TAS, Niggli value, colour index*
- 2.3 Petrographic Province. Different variation diagrams and their applications.
- 2.4 Crystallization of basaltic magmas, **classification of Basaltic magma*.
- 2.5 Generation of **Granite and Basaltic* magma with reference to plate tectonics.

UNIT - III

Study the petrogenetic significance of following silicate systems:

- 3.1 Albite-Anorthite and Forsterite – Silica, **Eutectic, Cotectic, Labile Stage, Synthetic component, phase, System, Phase rule*.
- 3.2 Diopside-Albite-Anorthite and Diopside-forsterite-silica
- 3.3 Nepheline-kalsilite-silica
- 3.4 Dioside-Forsterite-Nepheline-Silica.

UNIT – IV

Petrogenetic study of the following rock types and their distribution in India:

- 4.1 Basalt and Ophiolite
- 4.2 Peridotite, Ultramafite, **Dunite, Peridoite*
- 4.3 Granite, Anarthosite, **Syenite*
- 4.4 Komatite, Kimberlite and Lamproite
- 4.5 *Carbonatite, Lamprophyre,*

UNIT- V

- 5.1 Mid-ocean ridge volcanism and oceanic intra-plate volcanism.
- 5.2 Magmatism associated with subduction related igneous activity- continental and island arcs.
- 5.3 Magmatism in Large Igneous Plutons and continental alkaline magmatism.
- 5.4 **Petrographic province of India.*

Books recommended:

- Bose, M.K. (1997): Igneous Petrology, World Press, Kolkata.
- Best, Myron G. (2002): Igneous and Metamorphic Petrology, Blackwell Science.
- Cox, K.G., Bell, J.D. and Pankhurst, R.J. (1993): The Interpretation of Igneous Rocks, Chapman and Hall, London.
- Faure, G. (2001): Origin of Igneous Rocks, Springer.

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- Hall, A. (1997): Igneous Petrology, Longman.
- LeMaitre R.W. (2002): Igneous Rocks: A Classification and Glossary of Terms, Cambridge University Press.
- McBirney (1994): Igneous Petrology, CBS Publ., Delhi.
- Phillpotts, A.R. (1994): Principles of Igneous and Metamorphic Petrology, Prentice Hall of India.
- Sood, M.K. (1982): Modern Igneous Petrology, Wiley-Interscience Publ., New York.
- Srivastava, Rajesh K. and Chandra, R., (1995): Magmatism in Relation to Diverse Tectonic Settings, A.A. Balkema, Rotterdam.
- Wilson, M. (1993): Igneous Petrogenesis, Chapman and Hall, London.
- Winter, J.D. (2001): An Introduction to Igneous and Metamorphic Petrology, Prentice Hall, New Jersey.

**M.SC. GEOLOGY
SEMESTER – II
PAPER-II
METAMORPHIC PETROLOGY**

UNIT – I

- 1.1. Definition of metamorphism, significance of metamorphic rocks.
- 1.2. Agents and kinds of metamorphism.
- 1.3. Phase rule and its application in metamorphism.
- 1.4. Structure and texture of metamorphic rocks and their significance.
Classification of metamorphic rocks.

UNIT – II

- 2.1 Fabric of metamorphic rocks.
- 2.2 Evolution of the concept of depth zones. Systematic study of Barrovian and Abukuma zones of metamorphism.
- 2.3 Grade of metamorphism, Isograde & Isoreactiongrade and construction of petrogenetic grids.
- 2.4 Concept of facies and facies series.

UNIT- III

- 3.1 Study of ACF, AKF and AFM diagrams.
- 3.2 Polymetamorphism and paired metamorphic belts.
- 3.3 Metamorphic differentiation.
- 3.4 Retrograde Metamorphism and Crystalloblastic series.

UNIT - IV

- 4.1 General Characters of thermal and regional metamorphism of limestone, shale and basic igneous rocks.
- 4.2 Metamorphism in relation to magma and orogeny.
- 4.3 Metasomatism _ principles and types of metasomatism. Granitization.
- 4.4 Anataxis, Palingenesis. Origin of Migmatites in the light of experimental studies.

UNIT-V

- 5.1 Kinetics of metamorphic mineral reaction. Pressure – temperature – time paths.
- 5.2 Ultra-high temperature and ultra-high pressure and ocean floor metamorphism.
- 5.3 Layering in metamorphic rocks.
- 5.4 Petrogenetic significance of following rocks with special reference to Indian occurrences: charnockite, amphibolite, Khondalite, Gondite, Eclogite, and Blue schist.

Books Recommended:

- Blatt, H. and Tracy, R.J. (1996): Petrology (Igneous, Sedimentary, Metamorphic), W.H. Freeman and Co., NewYork.
- Bucher, K. and Martin, F. (2002): Petrogenesis of Metamorphic Rocks (7th Rev. Ed.), Springer-Verlag,.
- Kerr, P.F. (1959): Optical Mineralogy, McGraw Hill Book Company Inc., New York.
- Philpotts, A.R. (1994): Principles of Igneous and Metamorphic Petrology, Prentice Hall.
- Powell, R. (1978): Equilibrium thermodynamics in Petrology: An Introduction, Harper and Row Publ., London.

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- Rastogy, R.P. and Mishra, R.R. (1993): An Introduction to Chemical Thermodynamics, Vikash Publishing House.
- Spear, F. S. (1993): Mineralogical Phase Equilibria and pressure – temperature – time Paths, Mineralogical Society of America.
- Spry, A. (1976): Metamorphic Textures, Pergamon Press.
- Winter, J.D. (2001): An introduction to Igneous and Metamorphic Petrology, Prentice Hall.
- Wood, B.J. and Fraser, D.G. (1976): Elementary Thermodynamics for Geologists, Oxford University Press, London.
- Yardley, B.W.D., Mackenzie, W.S. and Guilford, C. (1995): Atlas of Metamorphic Rocks and their textures, Longman Scientific and Technical, England.
- Yardley, B.W.D. (1989): An introduction to Metamorphic Petrology, Longman Scientific and Technical, New York.

**M.SC. GEOLOGY
SEMESTER- II
PAPER-III
SEDIMENTOLOGY AND TECTONICS**

UNIT- I

- 1.1. Earth surface system – liberation and flux of sediments. **Sedimentation & diagenesis*.
- 1.2. Processes of transport and generation of sedimentary structures. Flow regimes and related bed forms
- 1.3. Stromatolites and their significance.
- 1.4. Textural analysis of sediments, Graphical representation, statistical treatment and geological significance.

UNIT – II

- 2.1 Classification of sandstone and carbonate rocks. Dolomite and dolomitization.
- 2.2 Volcaniclastics. Sedimentary environments and facies.
- 2.3 Continental: alluvial-fluvial facies, Lacustrine, Desert – Aeolian and glacial sedimentary environments, **Marine Environment*.
- 2.4 Shallow coastal clastics and shallow water carbonates.

UNIT – III

- 3.1 Evaporites. Deep-sea basins, **Shallow basin*.
- 3.2 Paleocurrents and basin analysis **with reference to Indian example*.
- 3.3 Clastic Petrofacies. Palaeoclimates and paleoenvironment analysis.
- 3.4 Diagenesis of sandstone and carbonate rocks – changes in mineralogy, fabric, and chemistry.

UNIT- IV

- 4.1 Pathogenesis of arkoses, greywacke and quartz arenites.
- 4.2 Concept of Geochemical and biogeochemical cycles and global climates.
- 4.3 Application of Trace, REE and stable isotopes geochemistry to sedimentological problems.
- 4.4 Surface features of earth – island arcs, mid-oceanic ridges, Young mountain belts and their distribution. Evolution of continental and oceanic crust.

UNIT - V

- 5.1 Plate Tectonics. Plate margins. Evolution of sedimentary basins in the context of Plate Tectonics.
- 5.2 Tectonics of Precambrian Orogenic belts.
- 5.3 Anatomy of Orogenic belts and formation of mountain roots.
- 5.4 **Structure and origin of Himalayan belt*.

Books Recommended:

- Blatt, H., Middleton, G.V. and Murray, R.C. (1980): Origin of Sedimentary Rocks, Prentice-Hall Inc.
- Collins, J.D., and Thompson, D.B. (1982): Sedimentary Structures, George Allen and Unwin, London.
- Lindholm, R.C. (1987) A Practical Approach to Sedimentology, Allen and Unwin, London.
- Miall, A.D. (2000): Principles of Basin Analysis, Springer-Verlag.

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- Pettijohn, F.J. (1975): Sedimentary Rocks (3rd Ed.), Harper and Row Publ., New Delhi.
- Reading, H.G. (1997): Sedimentary Environments and facies, Blackwell Scientific Publication.
- Reineck, H.E. and Singh, I.B. (1973): Depositional Sedimentary Environments, Springer-Verlag.
- Selley, R. C. (2000) Applied Sedimentology, Academic Press.
- Tucker, M.E. (1981): Sedimentary Petrology: An Introduction, Wiley and Sons, New York.
- Tucker, M.E. (1990): Carbonate Sedimentology, Blackwell Scientific Publication.
- Allen P. A. and J.R.L. Allen (2005): Basin Analysis: Principles and Application, Blackwell Publ.
- Perry, C.T. and Taylor, K.G. (2006): Environmental Sedimentology, Blackwell Publ., U.K.
- Bird, J.M. (1980): Plate Tectonics, American Geophysical Union, Washington D.C.
- Briggs, J.C. (1987): Biogeography and Plate Tectonics, Elsevier.
- Lieberman, B. L.(2000): Paleobiogeography: using fossils to study Global Change, Plate Tectonics and Evolution, Plenum Publ., New York.
- Jacquelyne Kious, J. and Tilling, R.I. (2007): This Dynamic Earth: The story of Plate Tectonics, USGS Information Services.
- Gass I.G. (1982): Understanding the Earth. Artemis Press (Pvt) Ltd. U.K.
- Windley B. (1973): The Evolving continents, John Wiley and Sons, New York.

**M.SC. GEOLOGY
SEMESTER - II
PAPER-IV**

STRATIGRAPHIC PRINCIPLES AND INDIAN GEOLOGY

UNIT – I

- 1.1. Principles of stratigraphic scales and its divisions, dual classification.
- 1.2. Stratigraphic units – lithostratigraphic, biostratigraphic and chronostratigraphic.
- 1.3. Rules of stratigraphic nomenclature.
- 1.4. Stratigraphic correlation.

UNIT – II

- 2.1 Concept of sequence stratigraphy.
- 2.2 Chief divisions of Indian sub-continent and their physiographic characters.
- 2.3 Archaean Era. Distribution and classification in Peninsula (Mysore, Bihar, M. P. and Rajasthan) and extrapeninsular regions. Their correlation and economic importance.
- 2.4 Dharwar Supergroup (Classification, Distribution, Economic importance)

UNIT – III

- 3.1 Cuddaph Supergroup its distribution, classification & equivalent in extra peninsula.
- 3.2 Vindhyan Supergroup – its distribution classification age economic importance and correlation.
- 3.3 Chhattisgarh Group, Indravati Group and Khairagarh Group, their classification, age correlation and economic importance.
- 3.4 Palaeozoic formations of extra peninsular regions with special reference to their classification distribution and correlation.

UNIT – IV

- 4.1 Distribution, geological succession, classification and climate of Gondwana Supergroup. Age and correlation of Gondwana formations.
- 4.2 Jurassic system of rocks – in extrapeninsular region.
- 4.3 Distribution, Classification & correlation of cretaceous formations of Peninsula and extra peninsulas regions of India.
- 4.4 Distribution, structural features and age of the Deccan Traps.

UNIT – V

- 5.1 Inter-trappeans and infra-trappeans of India.
- 5.2 Problems of Permo-triassic and Cretaceous – Palaeocene boundaries.
- 5.3 Distribution, succession, correlation and life of Siwalik formations.
- 5.4 Distribution, lithology, correlation & life of the Cenozoics of Assam & Western India and Pleistocene (Quaternary) deposits, Karewa Beds, Indogangetic Alluvium.

Books Recommended:

- Boggs, S. (2001): Principles of Sedimentology and Stratigraphy, Prentice Hall.
- Danbar, C.O. and Rodgers, J. (1957): Principles of Stratigraphy, John Wiley and Sons.
- Doyle, P. and Bennett. M.R. (1996): Unlocking the Stratigraphic Record, John Wiley and Sons.
- Krishnan, M.S. (1982): Geology of India and Burma, C.B.S. Publ. and Distributors, Delhi.
- Naqvi, S.M. and Rogers, J.J.W. (1987): Precambrian Geology of India, Oxford University Press.

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- Pascoe, E.H. (1968): A Manual of the Geology of India and Burma (Vols.I-IV), Govt. of India Press, Delhi.
- Pomerol, C. (1982): The Cenozoic Era? Tertiary and Quaternary, Ellis Harwood Ltd., Halsted Press.
- Schoch, Robert, M. (1989): Stratigraphy: Principles and Methods, Van Nostrand Reinhold, New York.
- Krumbein and Sloss (1963): Stratigraphy and sedimentation II Ed.Freeman & Co.

**M.SC. GEOLOGY
SEMESTER – II
PRACTICAL
LAB COURSE – I**

A: IGNEOUS & METAMORPHIC PETROLOGY

1. Megascopic description and identification of igneous and metamorphic rocks.
2. Study of textures and structures of Igneous and metamorphic rocks.
3. Microscopic identification of Igneous and metamorphic rocks.
4. C.I.P.W. Norm calculations and classification of igneous rocks.
5. Constructions of variation diagrams of igneous suits of rocks.
6. Construction of A.C.F., A.K.F. and A.F.M. diagrams.
7. Plotting the Geographical distribution of Igneous and Metamorphic rocks types in and outline map of India.

B: SEDIMENTARY PETROLOGY AND STRATIGRAPHY

1. Megascopic description and identification of sedimentary rocks.
2. Study of sedimentary structures in hand specimen.
3. Microscopic study of sedimentary rocks.
4. Graphic representation of sedimentary data and interpretation.
5. Heavy mineral studies of sediments.
6. Distribution of Important geological formations on outline map of India.
7. Construction of fence diagrams
8. Correlation diagrams. Recognition of transgressive-regressive cycles based on vertical columns.

**LAB COURSE – II
GEOLOGICAL FIELD WORK**

1. Geological mapping in type areas of India to study structural relations and stratigraphic formations in sedimentary, igneous and metamorphic terrains.
2. Collection and study of primary and secondary structures of rock bodies and their interpretation.
3. Sampling of rocks, minerals and fossils in the field from study areas.
4. Preparation of geological maps and sections from the geological data obtained in the field.
5. Preparation of geological report based on field studies.
6. Viva-Voce on fieldwork and geological report.

**M.SC. GEOLOGY
SEMESTER - III
PAPER-I
PALAEONTOLOGY**

UNIT – I

- 1.1. Definition of fossil and modes of fossilization their application in age determination, paleoclimatology, palaeogeography and evolution.
- 1.2. Modes and theories of organic evolution, concept of bathymetric distribution of animals, migration and extinction of species.
- 1.3. **Mass extinction event*.
- 1.4. Study of morphology, classification, evolutionary trends and geologic and geographic distribution of Brachiopod.

UNIT – II

Study of morphology, Classification, Evolutionary geologic history of the following.

- 2.1 Pelecypoda (Lamellibranches)
- 2.2 Gastropoda.
- 2.3 Cephalopoda
- 2.4 Trilobites.

UNIT – III

Study of morphology, Classification, Evolutionary geologic history of the following.

- 3.1 Echinoids. Graptolites and Rugose Corals.
- 3.2 An elementary idea about the origin of major groups of vertebrates.
- 3.3 Study of evolutionary history of Horse and Elephant, Man.
- 3.4 **Study of Reptiles – Dinosaurs, Study of Pices – Fishes.*

UNIT – IV

- 4.1 General study of Siwalik mammalian fauna.
- 4.2 Plant life through geologic ages.
- 4.3 Study of fossil flora of Gondwana Group and Tertiary Formations of India.
- 4.4 Definition and scope of micropaleontology.

UNIT - V

- 5.1 Techniques in micropaleontology.
- 5.2 Application of microfossils in stratigraphic correlation, age determination and palaeo-environmental interpretations.
- 5.3 Study of morphology of foraminifers.
- 5.4 Classification, evolution and geological distribution of foraminifers.

Books Recommended:

- Boardman, R.S., Cheethan, A.M. and Rowell, A.J. (1988): Fossil Invertebrates, Blackwell.
- Clarksons, E.N.K. (1998): Invertebrate Paleontology and Evolution, Allen and Unwin, London.
- Dobzhansky, Ayala, Stebbins and Valentine (1977): Evolution, Freeman.
- Horowitz, A.S. and Potter, E.D. (1971): Introductory Petrography of Fossils, Springer Verlag.
- Mayr, E. (1971): Population, Species and Evolution, Harvard.

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- Prothero, D.R. (2004): Bringing Fossil to Life – An Introduction to Paleontology (2nd Ed.), McGraw Hill.
- Raup, D.M. and Stanley, S.M. (1985): Principles of Paleontology ,CBS Publ..
- Smith, A.B.(1994): Systematics and Fossil Record – Documenting Evolutionary Patterns, Blackwell.
- Streat, C.W. and Carroll, R.L. (1989): Paleontology – the record of life, John Wiley.
- Bignot, G., Grahm and Trottmann (1985): Elements of Micropaleontology, London.
- Romer, A.S. (1966): Vertebrate Paleontology (3rd Edn.) Chicago University Press.

**M.SC. GEOLOGY
SEMESTER - III
PAPER-II
ORE AND FUEL GEOLOGY**

UNIT – I

- 1.1. Modern concepts of ore genesis. Spatial and temporal distribution of ore deposits _ Global perspective.
- 1.2. Concept of ore bearing fluids, their origin and migration. Fluid inclusion in ores – limitations and applications.
- 1.3. Texture, paragenesis and zoning in ores.
- 1.4. Wall rock alteration. Structural, physico-chemical and stratigraphic controls of ore localization.

UNIT – II

- 2.1 Orthomagmatic ores of mafic-ultramafic association _ Diamonds in Kimberlites, REE in Carbonatite, Ti -V Ores, Chromite and PGE, Ni Ores.
- 2.2 Cyprus type Cu-Zn Ores.
- 2.3 Ores of Silicic igneous rocks _ Kiruna type Fe-P. Pegmatoids, Greisen and Skarn deposits.
- 2.4 Porphyry associations – Kuroko type Zn-Pb-Cu, Malanjkhand Type Cu-Mo deposits.

UNIT – III

- 3.1 Ores of Sedimentary affiliations _ Chemical and Clastic sediments. Stratiform and Stratabound ore deposits. (Fe, Mn, non ferrous). Placers and paleoplacers.
- 3.2 Ores of Metamorphic affiliations. Metamorphism of ores and metamorphogenic ores.
- 3.3 Ores related to weathered surfaces – Bauxite, Ni and Au laterite.
- 3.4 Mineralogy, genesis, distribution in India and uses of Cu, Pb, Zn.

UNIT- IV

Mineralogy, genesis, distribution in India and uses of following ore deposits:

- 4.1 Iron and manganese
- 4.2 Gold and Silver
- 4.3 Aluminum and chromium
- 4.4 National Mineral Policy and mineral concession rules.

UNIT – V

- 5.1 Definition and origin of Kerogene and coal. Rank, Grade and type of coal. Microscopic constituents of coal.
- 5.2 Chemical characterization of coal Proximate and Ultimate analysis. Coal bed methane.
- 5.3 Distribution of Coal in India. Origin, nature and migration of oil and gas. Characteristics of reservoir rocks.
- 5.4 Oil bearing basins of India. Geology of productive oil fields of India. Mode of Occurrence and association of atomic minerals in nature. Productive geological horizons, **Sedimentary basin*.

Books Recommended:

- Branes, H.L. (1979): Geochemistry of Hydrothermal Ore Deposits, John Willey.
- Cuilbert, J.M. and Park, Jr. C.F.(1986): The Geology of Ore Deposits, Freidman.
- Evans, A.M. (1993): Ore Geology and Industrial Minerals, Blackwell.
- James R. Craig and David J.Vaughan (1994): Ore Microscopy and Petrography.

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SESSION 2021-22**

- Klemm, D.D. and Schnieder, H.J. (1977): Time and Strata Bound Ore Deposits, Springer-Verlag.
- Mookherjee, A. (2000): Ore Genesis-A Holistic Approach, Allied Publisher.
- Ramdhor, P. (1969): The Ore Minerals and their Intergrowths, Pergamon Press.
- Stanton, R.L. (1972): Ore Petrology, McGraw Hill.
- Wolf, K.H. (1976-1981): Hand Book of Stratabound and Stratiform Ore Deposits, Elsevier Publ..
- Chandra, D., Singh, R.M. Singh, M.P. (2000): Textbook of Coal (Indian context), Tara Book Agency, Varanasi.
- Singh, M.P. (1998): Coal and organic Petrology, Hindustan Publishing Corporation, New Delhi.
- Textbook of Coal petrology, Gebruder Borntraeger, Stuttgart.
- Van Krevelen, D. W. (1993): Coal :Typology-Physics-Chemistry-Constitution), Elsevier Science, Netherlands.
- North, F.K. (1985): Petroleum Geology, Allen Unwin.
- Selley, R.C. (1998): Elements of Petroleum Geology, Academic Press.
- Mineral Concession Rules 1960 (2005), IBM, Nagpur.
- Sinha, R.K. and Sharma, N.L. (1976): Mineral economics, Oxford and IBH Publ.

**M.SC. GEOLOGY
SEMESTER - III
PAPER-III
GEMORPHOLOGY AND REMOTE SENSING**

UNIT – I

- 1.1. Geomorphic concepts and geomorphic cycle.
- 1.2. Geomorphic processes – Weathering, soil-processes, Mass-Wasting.
- 1.3. Valley development, cycle of erosion, rejuvenation.
- 1.4. Drainage patterns and their significance.

UNIT – II

- 2.1 Fluvial landforms and Glacial landforms
- 2.2 Karst topography.
- 2.3 Arid and Aeolian landforms
- 2.4 Coastal and volcanic landforms.

UNIT – III

- 3.1 Terrain evaluation and concept of morphometric analysis.
- 3.2 Geomorphological mapping based on genesis of landforms.
- 3.3 Geomorphic regions of India. Principles of terrain analysis.
- 3.4 Concept and physical basis of remote sensing: terrestrial, aerial and space platforms. Advantages and limitations, **Satellite navigation – GNSS, GPS, DGPS with special reference to NavIC.*

UNIT – IV

- 4.1 **Principles of Remote Sensing and Electromagnetic Spectrum EMR Bands.*
- 4.2 Interaction of EMR with atmosphere and earth surface features, **Atmospheric Window.*
- 4.3 Remote sensing sensors, data acquisition, visual interpretation and digital processing techniques. Interpretation of topographic and tectonic features
- 4.4 Aerial photography, photographs and their geometry. Photogrammetry.

UNIT - V

- 5.1 **Satellite – Classification on basis of Orbit, Concept of radiometric, Spectral, Spatial and Temporal resolution of satellite.*
- 5.2 **Indian Satellite mission with special reference to Indian extra-terrestrial missions.*
- 5.3 **Application of Remote Sensing in Geology, Geomorphology, Natural Resource Mapping, Urban Planning*
- 5.4 **GIS – Definition, Component, Application and Limitations, GIS softwares, Applications of GIS in Geology.*

Books recommended:

- Drury, S.A. (2001): Image Interpretation in Geology, Allen and Unwin.
- Gupta, R.P. (1991): Remote Sensing Geology, Springer-Verlag.
- Halis, J.R. (1983): Applied Geomorphology.
- Holmes, A. (1992): Holmes Principles of Physical Geology, Edited by P. McL. D. Duff. Chapman and Hall.
- Lillesand, T.M. and Kiefer, R.W. (1987): Remote Sensing and Image Interpretation, John Wiley.
- Sharma, H.S. (1990): Indian Geomorphology, Concept Publishing Co., New Delhi.
- Siegal, B.S. and Gillespie, A.R. (1980): Remote Sensing in Geology, John Wiley.
- Thornbury, W.D. (1980): Principles of Geomorphology, Wiley Easton Ltd., New York.

**M.SC. GEOLOGY
SEMESTER - III
PAPER-IV
MINERAL EXPLORATION**

UNIT- I

- 1.1. Prospecting & Exploration: Definition and characteristic features. Reconnaissance. Preliminary and detailed investigation, surface and subsurface methods.
- 1.2. Guides to ore search: global, regional and local guides, detailed study of regional physiographic, stratigraphic, lithological, mineralogical and structural guides. Persistence of ore in depth.
- 1.3. Drilling: Type of drills, Diamond drilling, Drilling records and logs, Duty of geologists during drilling.
- 1.4. Sampling: General principles, various methods and procedures, Average assays, weighting of samples, salting. Precautions.

UNIT- II

- 2.1 Calculating grade and tonnage of ore: Average grade, volume, specific gravity, tonnage factor, calculations from data obtained from bore holes, prospecting pits, trenches, ore blocks, geological maps and sections.
- 2.2 Gravity Method of prospecting: Basic principles of gravimeter. Gravity field surveys. Various types of corrections applied to gravity data.
- 2.3 Preparation of gravity anomaly maps. And their interpretation in terms of shape, size and depth.
- 2.4 Magnetic method of prospecting: Magnetic properties. Magnetic anomaly. Magnetometer. Field survey and data reduction. Preparation of magnetic anomaly maps. Aeromagnetic surveys.

UNIT-III

- 3.1 Seismic prospecting: Fundamentals of seismic wave propagation, Methods of seismic prospecting and interpretation of seismic data.
- 3.2 Basic principles of resistivity method. Resistivity survey. Application and interpretation of resistivity data. S. P. Method and interpretation of data obtained by S. P. Method.
- 3.3 Radiometric prospecting and Borehole Logging. Radiometric survey, Application and interpretation of data.
- 3.4 Borehole logging: Principles of various borehole-logging methods, Interpretation of data.

UNIT- IV

- 4.1 Geochemical cycle, Forms of primary and secondary dispersion of elements. Secondary dispersion processes and anomalies.
- 4.2 Factors affecting dispersion patterns. Main types of geochemical surveys.
- 4.3 Methods of litho-geochemical and pedo-geochemical surveys.
- 4.4 Methods of hydro-geochemical, atmo-geochemical and biogeochemical surveys.

UNIT - V

- 5.1 Case studies of regional exploration for deposits of plutonic associations and vein and replacement types.
- 5.2 Analytical methods – sample preparation and decomposition. Precision and accuracy.
- 5.3 Instrumentation and applications of Atomic absorption spectrometer, Emission spectrograph and XRF.

5.4 Statistical treatment of geochemical data.

5.5 **Applications of Remote Sensing in Mineral Exploration*

Books Recommended:

- Arogyaswami, R.P.N. (1996): Courses in Mining Geology, Oxford and IBH Publ.
- Bagchi, T.C., Sengupta, D.K., Rao, S.V.L.N. (1979): Elements of Prospecting and Exploration, Kalyani Publ.
- Banerjee, P.K. and Ghosh, S. (1997): Elements of Prospecting for Non-fuel Mineral deposits, Allied Publ.
- Chaussier, Jean – Bernard and Morer, J. (1987): Mineral Prospecting Manual., North Oxford Academic.
- Dhanraju, R. (2005): Radioactive Minerals, Geol. Soc. India, Bangalore.
- Rajendran, S. (2007): Mineral Exploration: Recent Strategies.
- Sinha, R.K. and Sharma, N.L. (1976): Mineral economics, Oxford and IBH Publ.

**M.SC. GEOLOGY
SEMESTER – III
PRACTICAL
LAB COURSE - I**

Ore Geology and Mineral Exploration

1. Megascopic study of metallic and nonmetallic economic minerals. Description and identification, uses and distribution in India.
2. Description and identification of ore minerals in polished section of ores.
3. Study of ore textures and structure under the microscope.
4. Paragenetic study of ore minerals and construction of Paragenetic diagrams.
5. Location of important metallic and non-metallic mineral compels in a map of India.
6. Calculation of ore reserves and assay values.
7. Study and interpretations of Isopach and Isograde maps.
8. Evaluation of simple mining plans.
9. Interpretation of Geophysical and geochemical anomaly maps.
10. Numerical problems based on Geophysical and geochemical data.

LAB COURSE - II

[A] Paleontology

1. Study and identification of important invertebrate, vertebrate and plant fossils. Drawing of neat sketches of fossils.
2. Sketching and labeling of representative fossil specimens.
3. 3 Identification and study of important foraminifers.

[B] Geomorphology and Remote Sensing.

1. Identification and interpretation of drainage patterns
2. Drawing of labeled diagrams of landforms
3. Determination of stream order, bifurcation ratio, drainage density, stream frequency, infiltration number.
4. Slope studies of landforms.
5. Study of aerial photographs and satellite imageries and identification of landforms.

M.SC. GEOLOGY
SEMESTER - IV
PAPER-I

MINING AND ENGINEERING GEOLOGY

UNIT – I

- 1.1. Definition of mining terms: pitting, trenching, panning, adits, tunnels, and shafts.
- 1.2. Role of geologist in mining industry. Strata control in different rocks and structures.
- 1.3. Geological structures of ore deposits and choice of mining methods.
- 1.4. Subsidence and rock bursts, mine supports, Ventilation and drainage.

UNIT – II

- 2.1 Open pit mining- geologic and geomorphic conditions, different methods of opencast mining, advantages and limitations.
- 2.2 Underground mining methods- gophering, shrinkage, stoping, caving and slicing sublevel, over hand, under hand methods.
- 2.3 Coal mining methods, long wall, board and pillar.
- 2.4 Engineering properties of rocks and soil. Physical characters of building stones. Metal concrete aggregate.

UNIT - III

- 3.1 Role of geologist in civil construction projects.
- 3.2 Geological considerations for evaluation of Dam and reservoir sites. Dam foundation problems. Dam failure.
- 3.3 Geotechnical evaluation of tunnel alignment and transportation routes. Methods of tunneling.
- 3.4 Classification of ground for tunneling purposes. Various types of supports.
- 3.5 **Bridge – Site Selection, Construction, Geological Considerations.*

UNIT - IV

- 3.1 General principles, economic justification and scope of mineral dressing.
- 3.2 Properties of rocks and minerals as applied to mineral dressing.
- 3.3 Primary and secondary breaking, crushing and grinding, liberation by sizes, reduction.
- 3.4 Principles and methods of screening.
- 3.5 Principles and methods of classification, classification as a means of concentration.

UNIT- V

- 4.1 Concentration methods, hand sorting, washing, jigging, tabling heavy fluid.
- 4.2 Magnetic and electrostatic methods of separation of minerals.
- 4.3 Flotation methods- Principles and techniques with examples.
- 4.4 Application of ore microscopy in mineral dressing.
Concentration methods- with flow sheets of common types of mineral and ore dressing practises in India - Gold, copper, Lead-zinc, coal, beach sand, fluorite, iron, manganese, chromite and limestone.

Books Recommended:

- Dobrin, M. B.; Savit, C. H. (1988): Introduction to Geophysical Prospecting, McGraw-Hill.
- Keary, P., Brooks, M. and Hill, I. (2002): An introduction to geophysical exploration, (3rd Ed.), Blackwell.
- Krynine, D.H. and Judd, W.R. (1998): Principles of Engineering Geology, CBS Publ..
- Rider, M. H. (1986): Whittles Publishing, Caithness. The Geological Interpretation of Well Logs, (Rev. Ed.).
- Schultz, J.R. and Cleaves, A.B. (1951): Geology in Engineering, John Willey and Sons, New York.
- Singh, P. (1994): Engineering and General Geology, S.K. Kataria and Sons, Delhi.

**M.SC. GEOLOGY
SEMESTER - IV
PAPER-II**

ENVIRONMENTAL GEOLOGY & CLIMATOLOGY, OCEANOGRAPHY

UNIT- I

- 1.2 Definition, history and scope of Environmental Geology.
- 1.2 **Environment, Ecology, Ecosystems and habitat. Nature of its degradation.*
- 1.3 Basic concepts of Environmental Geology.
- 1.4 **Interaction of man and natural systems.*
- 1.5 **Environmental policies of the Government for air and water pollution. Environmental laws.*

UNIT- II

- 2.1 **Conservation principle, conservation of mineral and fuel resources.*
- 2.2 **Conservation of soil and water resources.*
- 2.3 *Problems of environment in urban areas, causes and remedies.*
- 2.4 **Geological hazards- Lands slides, volcanic activity, Earthquake. *Tsunami*
- 2.5 **Geological hazards -River flooding, erosion and sedimentation, coastal erosion, cyclones and tsunamis.*

UNIT- III

- 3.1 Draught and desertification, Measures of mitigation.
- 3.2 **Changes in surface and subsurface by mining activities.*
- 3.3 Transgression and Regression of sea. Measures of mitigation.
- 3.4 Human modifications of nature in surface and subsurface by engineering constructions dams, reservoirs, bridges and buildings.
- 3.5 **Human settlement and contamination of atmosphere, soil, surface water and groundwater by waste disposal and agro-industries.*

UNIT - IV

- 4.1 ** Isolation and Heat budget of Earth.*
- 4.2 **Classification of climate – Koppens and Thornthwaite.*
- 4.3 **Jet stream, Coriolis force, ITCZ.*
- 4.4 **El Nino and La Nina, ENSO.*

UNIT- V

- 5.1 **Ocean water circulation.*
- 5.2 **Cloud classification and its precipitation mechanics – Bergeron, Eindeisen process*
- 5.3 **Indian Monsoon, Western disturbances.*
- 5.4 **Coral reefs, its importance in Oceans, Physiology, Biological & its degradation. Coral bleaching.*

Books Recommended:

- Bryant, E. (1985): Natural Hazards, Cambridge Univ. Press.
- Keller, E.A.(1978): Environmental Geology, Bell and Howell, USA.
- Nagabhushaniah, H.S. (2001): Goundwater in Hydrosphere, CBS Publ.
- Perry, C.T. and Taylor, K.G. (2006): Environmental Sedimentology, Blackwell Publ.
- Singh, S. (2001): Geomorphology, Pustakalaya Bhawan, Allahabad.
- Todd, D.K. (1995): Groundwater Hydrology, John Wiley and Sons.
- Valdiya, K.S.(1987): Environmental Geology – Indian Context, Tata McGraw Hill.

**M.SC. GEOLOGY
SEMESTER - IV
PAPER-III
HYDROGEOLOGY**

UNIT- I

- 1.1 Scope of hydrogeology and its relation with hydrology, meteorology and their uses in the Hydrogeological investigation.
- 1.2 **Hydrologic cycle. Role of groundwater in the hydrologic cycle. Hydrograph, data collection and analysis.*
- 1.3 **Composition of Sea water and River water.*
- 1.4 Water table and piezometric surface. Water table fluctuation. Water table contour maps, interpretation and uses.

UNIT- II

- 2.1 Water bearing formation types - aquifers, aquitard, aquiclude, aquifuge. Aquifer types: perched, unconfined, semi-confined and unconfined, isotropic, anisotropic.
- 2.2 Porosity, permeability. Ground water movement: Darcy's law and its applications.
- 2.3 Specific yield and specific retention. Storativity and transmissivity.
- 2.4 Steady and unsteady flow, leaky aquifers. Groundwater flow near aquifer boundaries.

UNIT- III

- 3.1 Bounded aquifers. Image wells.
- 3.2 Wells and their types. Construction of wells.
- 3.3 Well Development and completion.
- 3.4 Pumping test and Yield of wells.

UNIT-IV

- 4.1 Geological and Hydrogeological methods of groundwater exploration.
- 4.2 Geophysical methods – Electrical resistivity method for groundwater exploration
- 4.3 Application of remote sensing in groundwater exploration.
- 4.4 Basin wise development of groundwater with special reference to Chhattisgarh region.

UNIT – V

- 5.1 Groundwater provinces of India.
- 5.2 Sources of dissolved constituents in groundwater. Groundwater quality standards- drinking, domestic, agriculture and industry. Groundwater pollution.
- 5.3 Groundwater management. Safe yield, overdraft and spacing of wells.
- 5.4 Conservation of Groundwater; conjunctive use of water. Artificial recharge.

Books Recommended:

- C.F. Tolman (1937): Groundwater, McGraw Hill , New York and London.
- D.K. Todd (1995): Groundwater Hydrology, John Wiley and Sons.
- F.G. Driscoll (1988): Groundwater and Wells, UOP, Johnson Div.St.Paul. Min. USA.
- H.M. Raghunath (1990): Groundwater, Wiley Eastern Ltd.,
- H.S. Nagabhushaniah (2001): Groundwater in Hydrosphere (Groundwater hydrology), CBS Publ..
- K. R. Karanth (1989): Hydrogeology, Tata McGraw Hill Publ..
- S.N. Davies and R.J.N. De Wiest (1966): Hydrogeology, John Wiley and Sons, New York

**M.SC. GEOLOGY
SEMESTER – IV
PRACTICAL
LAB COURSE – I**

150 Marks

[A] HYDRGEOLOGY

1. Hydrogeological properties of rocks.
2. Interpretation of water table maps.
3. Computation of pumping test data.
4. Interpretation of Hydrogeochemical data and their plotting in different diagrams.
5. Sieve analysis and screen gravel pack design.
6. Plotting of groundwater provinces on an outline map of India.
7. Computation of Resistivity (VES) data.

[B] ENGINEERING GEOLOGY AND MINING GEOLOGY

1. Interpretation of engineering properties of rocks in hands specimens.
2. Determination of compressive, tensile and sheer strength of rocks.
3. Determination of porosity and absorption of building materials.
4. Mechanical analysis of soils and unconsolidated materials.
5. Preparation of core-logs and their Geotechnical interpretation from bore hole data.
6. Plotting the geographical distribution of important dams, tunnels on the outline of India.
7. Terrain studies from satellite imageries, aerial photographs and Toposheet.

**M.SC. GEOLOGY
SEMESTER – IV
CORE ELECTIVE COURSES:
ME- I
ADVANCED HYDROGEOLOGY**

UNIT- I

- 1.1. Hydrologic cycle, ground water in hydrologic cycle
- 1.2. Hydrograph and hydrographic analysis
- 1.3. Water balance studies
- 1.4. Springs (including thermal): origin and movement of water.

UNIT- II

- 2.1 Geologic structures favouring groundwater movement. Methods of identification of groundwater reservoir properties.
- 2.2 Force and laws of groundwater movement.
- 2.3 Well hydraulics: confined, unconfined, unsteady and radial flow. Water level fluctuation. Causative factors and their measurements.
- 2.4 Water well technology: Well types, drilling methods, construction, designing development and maintenance of wells.

UNIT- III

- 3.1 Groundwater in arid and semiarid regions.
- 3.2 Groundwater in coastal and alluvial regions.
- 3.3 Groundwater in hard rocks and limestone terrain. Environmental impact on groundwater extraction.
- 3.4 Ground water recharge: artificial and natural. Factors controlling recharge. Conjunctive and consumptive use of groundwater.

UNIT- IV

- 4.1 Chemical characterization of groundwater in relation to domestic and industrial uses.
- 4.2 Chemical characterization of groundwater for irrigation purposes.
- 4.3 Water pollution: remedial measures and treatment
- 4.4 Problems of arsenic and fluoride in water.

UNIT-V

- 5.1 Geological and hydrogeological methods of groundwater exploration.
- 5.2 Geophysical surface resistivity and seismic methods in groundwater exploration. Geophysical water well logging.
- 5.3 Application of remote sensing and radiogenic isotopes in hydrogeological studies.
- 5.4 Basin-wise groundwater management.

Lab course: ME-I

Based on Course ME-I and field data collection and report writing.

**M.SC. GEOLOGY
SEMESTER – IV
CORE ELECTIVE COURSES:
ME-II
PROJECT ORIENTED DISSERTATION**

Script Evaluation	100
SEMINAR	25
VIVA VOCE	25

**Minor Elective
GMnE- I DISASTER MANAGEMENT**

UNIT- I

Brief Introduction about the Natural Disasters, such as: Floods, Droughts, Cyclone, Landslides, Earthquake and Tsunamis. Their causes and impacts.

UNIT-II

Brief introduction about the man-made Disasters, such as: nuclear, industrial accidents, environmental disasters, fires, rail accidents, road accidents, air accidents and sea accidents and their causes and impacts

UNIT –III

Understanding Hazard Risk Concept and Elements. Risk Analysis and Risk Assessment.

Resource Analyses and Mobilisation. Strategic Developments for Vulnerability Reduction

UNIT- IV

Disaster Preparedness: Conception and Nature. Disaster Management – Prevention, Preparedness and Mitigation. Use and Applications of Emerging Technologies in Disaster Preparedness.

UNIT- V

Disaster Response Plan. Communication, Participation, and Activation of Emergency Preparedness Plan. Logistics Management.

Books Recommended:

- Bell, F.G. (1999): Geological Hazards, Routledge, London.
- Bryant, E. (1985): Natural Hazards, Cambridge Univ. Press.
- Keller, E.A. (1978): Environmental Geology, Bell and Howell, USA.
- Lal, D. S. (2007): Climatology, Sharda Pustak Bhawan, Allahabad.
- Patwardhan, A.M. (1999): The Dynamic Earth System, Prentice Hall.
- Smith, K. (1992): Environmental Hazards, Routledge, London.
- Subramaniam, V. (2001): Textbook in Environmental Science, Narosa International.
- Valdiya, K.S. (1987): Environmental Geology – Indian Context, Tata McGraw Hill.