

**MANONMANIAM SUNDARANAR UNIVERSITY**  
**TIRUNELVELI**  
**PG - COURSES – AFFILIATED COLLEGES**  
 Course Structure for M.Sc. Geology  
 ( Choice Based Credit System)  
 ( with effect from the academic year 2017- 2018 onwards)

<b>Sem</b>	<b>Sub. No</b>	<b>Subject Status</b>	<b>Subject Title</b>	<b>Hrs./Week</b>	<b>Credits</b>
<b>Semester I</b>	<b>1</b>	<b>Core 1</b>	<b>Dynamic Geology and Environmental Geology</b>	<b>6</b>	<b>4</b>
	<b>2</b>	<b>Core 2</b>	<b>Paleontology</b>	<b>6</b>	<b>4</b>
	<b>3</b>	<b>Core 3</b>	<b>Structural Geology</b>	<b>6</b>	<b>4</b>
	<b>4</b>	<b>Core – Elective- 1</b>	<b>Marine Geology or Fuel Geology or Field Geology</b>	<b>4</b>	<b>4</b>
	<b>5</b>	<b>Practical I</b>	<b>Practical Based on Dynamic Geology and Paleontology</b>	<b>4</b>	<b>4</b>
	<b>6</b>	<b>Practical II</b>	<b>Practical Based on Structural Geology and Elective Core- Marine Geology</b>	<b>4</b>	<b>4</b>
<b>Semester II</b>	<b>7</b>	<b>Core 6</b>	<b>Crystallography and Mineralogy</b>	<b>6</b>	<b>4</b>
	<b>8</b>	<b>Core 7</b>	<b>Indian Stratigraphy</b>	<b>6</b>	<b>4</b>
	<b>9</b>	<b>Core 8</b>	<b>Hydrogeology</b>	<b>6</b>	<b>4</b>
	<b>10</b>	<b>Core – Elective- 2</b>	<b>Remote Sensing and GIS or Isotope Geology or Geoexploration</b>	<b>4</b>	<b>4</b>
	<b>11</b>	<b>Practical III</b>	<b>Practical Based on Crystallography and Mineralogy and Indian Stratigraphy</b>	<b>4</b>	<b>4</b>
	<b>12</b>	<b>Practical IV</b>	<b>Practical Based on Hydrogeology and Elective Core Remote Sensing and GIS</b>	<b>4</b>	<b>4</b>

<b>Semester III</b>	<b>13</b>	<b>Core 7</b>	<b>Igneous Petrology</b>	<b>6</b>	<b>4</b>
	<b>14</b>	<b>Core 8</b>	<b>Sedimentary Petrology</b>	<b>6</b>	<b>4</b>
	<b>15</b>	<b>Core 9</b>	<b>Research Methodology</b>	<b>6</b>	<b>4</b>
	<b>16</b>	<b>Core – Elective- 3</b>	<b>Applied Geology- (Geophysics and Geochemistry, Engineering Geology, Mining Geology and Ore Dressing) or Social Geology or Nano Geoscience</b>	<b>4</b>	<b>4</b>
	<b>17</b>	<b>Practical V</b>	<b>Practical Based on Igneous and Sedimentary Petrology</b>	<b>4</b>	<b>4</b>
	<b>18</b>	<b>Practical VI</b>	<b>Practical Based on Research Methodology and Elective Core- Applied Geology</b>	<b>4</b>	<b>4</b>
<b>Semester IV</b>	<b>19</b>	<b>Core 10</b>	<b>Metamorphic Petrology</b>	<b>6</b>	<b>4</b>
	<b>20</b>	<b>Core 11</b>	<b>Economic Geology and Mineral economics</b>	<b>6</b>	<b>4</b>
	<b>21</b>	<b>Practical VII</b>	<b>Practical Based on Metamorphic Petrology and Economic Geology and Mineral economics</b>	<b>4</b>	<b>4</b>
	<b>22</b>	<b>Practical VIII</b>	<b>Geological Mapping and field studies Mapping. Short field trips and Professional training, Industrial Training and Specimen Collection. Viva voce on mapping, field training, industrial/Inplant training and short field trips.</b>	<b>4</b>	<b>4</b>
	<b>23</b>	<b>Core Project</b>	<b>Project field work, Lab work, dissertation project submission and, and Viva voce on Project</b>	<b>10</b>	<b>8</b>

**DYNAMIC GEOLOGY AND ENVIRONMENTAL GEOLOGY**

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<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>6</b>	<b>0</b>	<b>0</b>	<b>4</b>

**Objective:**

The paper deals with the principles of Geomorphology, Applied Geomorphology and Indian Geomorphology along with Plate Tectonics, Crystal Evolution endodynamic processes like earthquake, volcanoes & tectonic process and different aspects of environmental geology and geological hazards.

**Unit-I**

Concept –Assumptions, Problems and deficiencies of plate tectonics – Elements of tectonics - Lithosphere plates: Characteristics, Plate boundaries. Types, Recognition, Migration, Motion of plates, Causes and mechanism of plate movement-Mineral deposits along plate boundaries. Rock magnetism, Remnant magnetism: Magnetic reversals; Polar wandering curve – Geomagnetic time scale

**Unit -II**

Sea Floor spreading theory, evidence and mechanism- submarine canyons origin and distribution. Island arc systems: Single and double chain – General features – Causes for the arc, Evolution of Arc-Trench gap.

**Unit -III**

Description – Gravitational balance – Hypothesis of Pratt Airy, Heiskanen, Daly and Veining Meinesz – Isostatic adjustment – Effects. Sea level Changes: Minor and major – causes- climatic effect on sea level changes – Green House effect on sea level – Eustatic effect on coasts – Recognition of past sea levels – sea level trends during geological time.

**Unit-IV**

Fundamental concepts of environmental geology; scope objectives and aims. Impact of oceanic and atmospheric circulation on climate and rainfall. Global warming caused by CO<sub>2</sub> increase in presence atmosphere due to indiscrete exploitation of fossil fuels; volcanic eruption and deforestation. Surface geological process including river floods, soil erosion and desertification and their impact on environment.

**MSU / 2017-18 / P.G-College / M.Sc. (Geology) / Semester-I / Ppr.no.1 / Core – 1  
Unit-V**

Various causes, types, mitigation and management of earthquake, volcanism, landslides. Population explosion and pressure on air, surface and groundwater and soil. Environmental degradation due to mining, their impact and management.

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**Text Book:-**

1. Radhakrishnan, V., 1996. General Geology V.V.P. Publishers, Tuticorin.
2. Holmes .A .1992 Principles of physical geology.
3. Thornbury. 1969. Principles of geomorphology.
4. Strahler A.M ., The Earth Sciences?
5. Donald R. Coates 1981 .,Environmental Geology (Willey).
6. Peter T. Flawan 1970 ., Environmental Geology,Harper and Row.
7. Arthur N. Strahler and Alan H. Strahler 1973 ., Environmental Geoscience.
8. Valdiya, K.S. (1987) Environmental geology – Indian Context’ Tata McGraw Hill New Delhi 583p.
9. Keller. G., 1979 Environmental geology. 7<sup>th</sup> Edition. Printice Hall.560p.
10. Lundgren,L 1998. Environmental geology. . Printice Hall.511p.

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**PALAEONTOLOGY**

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<b>Objective:</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>6</b>	<b>0</b>	<b>0</b>	<b>4</b>

**The paper deals with the in-depth knowledge about the vertebrate animal's invertebrate, plant fossils and their evolution.**

**Unit-I**

Organic Evolution - Principle of Structural Changes – Evolution of Trilobite, Ammonite and Graptolite.

**Unit-II**

Vertebrate classification. Evolution of Equus, Elephas, Man, Bird – Archaeopteryx. Evolution of plant through various ages, Gondwana and Tertiary Flora of India.

**Unit-III**

Brief review of Micropalaeontological, Sampling methods, sample processing techniques. Bathymetric distribution of Microfossils. Morphology of Foraminifera and ostracods, classification, Geological history, Ecology, and Palaeoecology.

**Unit-IV**

Morphology of Bryozoa, Classification, Geological history, Ecology and Palaeoecology. Morphology of Diatoms - Classification, ecology and Palaeoecology. Brief introduction of morphological characteristic of Radiolaria, Conodonts, Stromatolites and Pterapods.

**Unit-V**

Briefly morphology of spores and Pollen and their geological significance in Petroleum exploration. Environmental significance of Microfossil, Determination of Age and Correlation of Palaeofacies and tectonism from micro Faunal evidence.

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**Text Book:-**

1. Krishnan M.S.,1982. Geology of India and Burma.
2. Romer, S.1960. Vertebrate Palaeontology, Chicago press,.
3. Arnold C.A., 1947. An introduction to palaeobotany..
4. Jones .J. 1958, An introduction to Microfossil, Harper brother.
5. Bignot G.1985, Elements of Micropalaeontology, Graham Trotman.Haug U. and A. Boersma, 1978. Introduction to marine micropalaeontology, Elsevier, Netherlands, 376 p.
6. Brasier, M.D. 1980. Microfossil.

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**STRUCTURAL GEOLOGY**

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**Objective:**

L	T	P	C
6	0	0	4

**The paper deals with the study of the folding and fracturing of rocks, Structural analysis of Metamorphic Tectonites and mostly the fundamental and modern developments in structural geology.**

**Unit-I**

Introduction to structural geology - GPS and their uses in Geological Mapping – Beds and their attitudes – Dip and Strike – Trends of outcrops – Rotation between true and apparent dips, width of outcrops, True thickness and vertical thickness and their mutual relations.

**Unit - II**

Mechanical properties of rock – Stress and strain and Types. Stress and strain ellipsoids – Mohr Circle. Physical properties of rocks-deformation - brittleness, plastic and elastic properties. Rock deformation and stage. Foliation, Types of cleavage, foliation, schistosity, crenulation- orientation of foliation within strain ellipsoid. Lineation-Types and relation to tectonic history.

**Unit-III**

Geometry and mechanics of folding, minor fold-origin and relation to major structure. Classification and types of folds and mechanics of similar folding. Recognitions of folds in the field. Salt intrusion and salt domes- Unconformities and types – Determination of top and bottom of beds.

**Unit-IV**

Study of joints - their classification and significances, Faults – Classification – types- Normal, thrust and slip faults. Mechanics of faulting with reference to stress and stress ellipsoids. Recognition of faults in the field classification and geometry of different types of shear zones. Strain variations within shear zone. Origin and significance of different types of minor structures within shear zone. Sense of movement and its determination in shear zones.

**Unit-V**

Principles and phase of structural analysis. Petro fabrics – field and laboratory technique - tectonites and their symmetry – Application of stereographic projection in the solving of structural problem. Structural analysis of areas of multi-deformation D1, D2 and D3.

**Text Book:-**

1. Billing, M.P., 1974. Structural Geology, Prentice Hall.
2. Hobbs, R.F. et.al .1976. An outline of structural geology, Wiley.
3. Hills, E.L., 1965. Elements of Structural Geology, Asia Publication House.
4. Belousov, V.V., 1954. Basic problems in Geotectonics, McGraw Hill.
5. De Sitter, U., 1956. Structural Geology, McGraw Hill.

6. Navin, C.M., 1953. Principle of Structural Geology, Wiley.
7. Ragan, D.M. – 1973 – Structural Geology, Wiley.
8. Ramsay, J.G. 1967 – folding and fracturing of rocks, McGraw Hill.
9. Philips, F.C. 1954 – The use of Stereographic projection in Structural Geology, Arnold Publishers.

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L	T	P	C
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**Objective:**

To understand the waves, tides, currents and bottom of the sea. It deals in detail about the law of the sea, marine deposits, beach minerals and instruments applications in sea.

**Unit-I**

**Ocean Basins:** History of Marine Geology – Marine Geology research Institutes and vessels of India - Origin, morphology and distribution of ocean basins - mid-ocean ridge systems - Raised and sunken features – Palaeocean basins.

**Unit-II**

**Marine Geology: Equipments and Deposition:** Principles of Echo sounder, Side scan sonar, underwater cameras and bottom samplers - Position fixing at Sea. Marine sedimentation – Sources and distribution of sediments – Transport of sea bottom sediment - Rate of deposition – Mineral resources of the oceans and the factors controlling their distribution. Stratigraphy and geochronometry of deep-sea deposits– phosphorite, glauconites, barium sulphate concretions, Polymetallic nodules- Beach placers.

**Unit-III**

**Marine Geochemistry:** Physico-chemical characteristic of seawater - distribution of temperature, salinity and density -for sea water - diagenetic changes in oxic and anoxic environments - mobility of redox metals - Sedimentary markers of palaeo environmental conditions - chemistry of oceanic rocks.

**Unit-IV**

**Marine Processes and features:** Waves, tides, currents, turbidity currents, longshore currents, rip currents, circulation, wave reflection, refraction and diffraction – Seiche and tsunamis – Causes of marine regression and transgression – Description of important regressions and transgressions in the geological past – Estuary – Littoral processes - Evolution of headlands and bays - Beaches, continental shelves, continental slopes, trenches and canyons – Abyssal plains and its various topographic features - ridges, seamounts, guyots, mud banks – Evolution and classification of sea coasts and shore lines.

**Unit-V**

**Marine Environment:** Man and ocean – Measures to control coastal erosion - Evolution of Coral reefs and its distribution along Indian Coast. Laws of the sea – Coastal zone regulation in India.

**Text Book:-**

1. Shephard, F.P., 1973. Submarine Geology, Harper and Row.
2. Kurekian, K.K., 1990. Ocean, Prentice Hall.
3. Seabold, E. and Berger, W.H., 1982. The Sea Floor, Springer Verlag.
4. Kuenen, Ph.H., 1950. Marine Geology. John Wiley and Sons.
5. King, C.A.M., 1959. Beaches and coasts, Edward Arnold, London.
6. King, C.A.M., 1975. Introduction to marine Geology and Geomorphology. Edward Arnold, London.
7. Radhakrishnan, V., 1996. General Geology V.V.P. Publishers, Tuticorin.
8. Shepard, F.P., 1978. Geological Oceanography, Heinmann, London.

**FUEL GEOLOGY**

L	T	P	C
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**Objective:**

**This paper is about the introduction to Petroleum Geology, Organic petrology and Petroleum Formation and Occurrence.**

**Unit-I**

Petroleum - its composition and different fractions; origin, nature and migration (primary and secondary) of oil and gas; transformation of organic matter into kerogene; surface and subsurface occurrence of petroleum and gas.

**Unit-II**

Characteristics of reservoir rocks and traps (structural, stratigraphic and correlation of strata); Prospecting for oil and gas, drilling and logging procedures; oil-bearing basins of India; geology of the productive oil fields of India; position of oil and natural gas in India; future prospects and the economic scenario.

**Unit-III**

Coal - Definition and origin of kerogen and coal; sedimentology of coal bearing strata; rank, grade and type of coal; Indian and International classifications of coal; macroscopic ingredients and microscopic constituents; concept of maceral and microlithotypes.

**Unit-IV**

Chemical characterization : proximate and ultimate analysis; coal petrology and its application in solving industrial and geological problems; preparation of coal for industrial purposes; coal carbonization (coke manufacture) coal gasification and coal hydrogenation. Coal bed – methane : a new energy resource.

**Unit-V**

Atomic fuel - Mode of occurrence and association of atomic minerals in nature; atomic minerals as source of energy; methods of prospecting and productive geological horizons in India; nuclear power stations of the country and future prospects; atomic fuels and environment.

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**Text Book:-**

1. Eicher, L.D .1968. Geological Time, Hall
2. Arkell, W.J. 1960. Jurassic geology of world Oliver & Boyd,
3. Levorsen, A.L., 1954. Geology of Petroleum, McGraw Hill Book Co.
4. Gokhale, K.V. and K.D. Rao, T.C., 1973. Ore deposits of India. Thomson Press India Ltd., Delhi.
5. Krishnaswamy, S., 1972. India's Mineral Resources, Oxford & IBH Publishing Co., Chennai.
6. Stanton, R.L., 1972. Ore petrology, McGraw – Hill Book Co.
7. Bateman, A.M., 1961. Economic Mineral Deposits, Asia Publishing House.
8. Serra, O., 1985. Sedimentary environments from wire line logs. Schlumberger.

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**FIELD GEOLOGY**

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L	T	P	C
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**Objective:**

**This paper is about the introduction to geological mapping, preparation of geological report and fieldwork in different terrain.**

**Unit-I**

**Geological mapping:** Reconnaissance – surface features – cuttings – quarries and mines- unconsolidated and residual deposits – soils – systematic mapping – strike and dip – contacts and boundaries – correlation geological cross section – making the map. Aerial photographs – stereoscopic image – scale of aerial photographs – locating outcrops- transferring geological features from photographs to map.

**Unit-II**

**Preparing geological report:** Nature of geological report – organizing starting the report – clarity of the report – index of the report – form of the report – planning and illustrating of the report – kinds of illustrations – drawing methods- geological mapping and cross section – stratigraphic illustration.

**Unit-III**

**Field work in Sedimentary rocks:** Interpretation of sedimentary rocks – lithological and time stratigraphic units – Naming and describing sedimentary rocks – beds and related structures – surface between beds – Unconformities. Tops and bottoms of the beds. Measuring stratigraphic sections. Sampling for micro fossils. Surface deposits and related landforms.

**Unit-IV**

**Field work in volcanic rocks:** Volcanic sequence and unconformities – structures of basic lavas – pyroclastic and closely related deposits – volcanic feeders and related intrusions. Concept of plutonic geology – contact of plutonic rocks – inclusion and related structures – Fracture and related structures in plutons.

**Unit-V**

**Field work with metamorphic rocks:** Studies of metamorphic rocks – premetamorphic lithology and sequence – Metamorphic deformation - joint and vein pattern in deformed rocks – mapping metamorphic zones. Migmatites and related rocks.

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**Text Book:-**

1. Compton R. R. 1994. Manual of Field Geology. Wiley Eastern pvt ltd. P378.
  2. Gokhale N WA Guide To Field Geology- Publisher : Cbs Publishers & Distributors- New Delhi.
  3. Mathur, S.M. Guide To Field Geology, Phi Learning Pvt. Ltd-New Delhi.
  4. Lahee, Frederic H. (Frederic Henry), b. 1884. Field geology. New York, London, McGraw-Hill Book Company, inc.p. 902
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**Practical I**  
**(Dynamic Geology and Environmental Geology and Paleontology)**

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**L T P C**  
**0 0 4 4**

- Calculation based on Dynamic Geology
- Study of the morphological characters of some important Invertebrate Fossils belonging to Brachiopoda, Pelecypoda, Gastropoda, Ceppalopods, Trilobita, Echinoidea, Corals and Plant fossils.
- Determination of valves and dental formula of Pelecypoda.
- Evolutionary study of Trilobites and Ammonites.
- Drawing neat sketches of Invertebrate fossil group and labeling parts and identification of fossil groups.

**Practical II**  
**(Structural Geology and Elective Core- Marine Geology)**

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**Structural Geology**

- Basic idea of topographic contours, Topographic sheets of various scales.
- Introduction to Geological maps: Lithological and Structural maps.
- Structural contouring and 3-point problems of dip and strike Drawing profile sections and interpretation of geological maps of different complexities
- Exercises of stereographic projections of mesoscopic structural data (planar, linear, folded etc.).

**Marine Geology**

- Beach profile survey and sediment sample collection.
- Estimation of salinity of seawater by Mohr-Knudsen's method – Determination of dissolved oxygen of seawater – Determination of pH of seawater – Determination of total alkalinity of seawater – Verification of Beer's Law.
- Graphical representation and interpretation of bathymetry data set- Study of bathymetry maps - Study of seismic profiles.

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**Text Book:-**

1. Davis, G. R. (1984) Structural Geology of Rocks and Region. John Wiley
  2. Billings, M. P. (1987) Structural Geology, 4th edition, Prentice-Hall.
  3. Park, R. G. (2004) Foundations of Structural Geology. Chapman & Hall.
  4. Pollard, D. D. (2005) Fundamental of Structural Geology. Cambridge University Press.
  5. Ragan, D. M. (2009) Structural Geology: an introduction to geometrical techniques (4<sup>th</sup> Ed). Cambridge University Press (For Practical)
  6. Lahee F. H. (1962) Field Geology. McGraw Hill
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**CRYSTALLOGRAPHY AND MINERALOGY**

**Objective:**

L	T	P	C
6	0	0	4

The paper deals with the introduction to the rock forming minerals and other concepts related to mineralogy and crystallography.

**Unit-I**

Derivation of 32 crystal classes of symmetry, Projections – Stereographic and Gnomonic projections of crystals belonging to normal classes; calculation of crystal elements making use of tangent relation. Napier's theorem and equation of the normal. Interfacial angle, zone symbols.

**Unit-II**

14 Bravais space lattices, Twinning, irregularities of crystals, Principles of X-ray diffraction – the Bragg's law. Principles & methods of X-ray powder diffraction.

**Unit-III**

Atomic structures – Chemical bonds- structural classification of silicate minerals – Isomorphism – solid solution- Atomic substitution - Exsolution- Order & Disorder & Disorder relation- Polymorphism Pseudomorphism - Fluorescence in minerals, metamict stage- Staining techniques.

**Unit-IV**

Description of chemical, Optical and physical properties of distinguishing features and paragenesis of the following; Ortho & Ring silicates –Olivine group, garnet group, aluminosilicates, epidote group, zircon, sphene, topaz, staurolite, beryl, cordierite, tourmaline.

**Unit-V**

General principles of optics – Optical accessories- Quartz wedge, Quarter plate-unit relation plate, Berek compensator, Micrometer ocular, Refrindex- Determination of R.I of minerals by immersion methods. Birefringence - Method of determination of extinction angle. Colour absorption in mineral and absorption formula sign of elongation. Optic angle, Optic sign determination, optic orientation, Dispersion, primary and secondary optic axis. Conical refraction, Optic anomalies.

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**Text Book:-**

1. Phillips, F.C. 1994. An introduction to Crystallography
2. Buerger, 1956. Elementary Crystallography
3. Dana, 1922. Text Book of Mineralogy
4. Kerr, P.F. 1959. Optical Mineralogy, McGraw-Hill Book Company, Inc.
5. Winchell, A.N. 1962. Elements of Optical Mineralogy, John Wiley.
6. Wahlstrom, E.E. 1942. Optical Crystallography.
7. Naidu., P.R.J. 1941. Text Book of Mineralogy.

8. Deir Howie K. Zussaman ., 1969. An Introduction to Rock Forming Minerals.

9. Berry L.G. and Brain Mason. 1968. Mineralogy.



**INDIAN STRATIGRAPHY**

<b>Objective:</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>6</b>	<b>0</b>	<b>0</b>	<b>4</b>

To learn about the geological time scale, principles of stratigraphy and the description of strata and their relationship to tectonics, climate, fossils along with their distribution in different parts of India from Precambrian to recent and geological boundary problems and applications of stratigraphy.

**Unit – I**

Principles of Stratigraphy - Correlation, Facies – Continental evolution during Archaean – Continental cycle. Life during Archean, Proterozoic, Palaeozoic, Mesozoic, and Cenozoic. Description, critical study and correlation of Archaean. Dhaewar Province, Easter Ghats Province, Central Indian Province, Singhbhum-Orissa and Aravalli-Bundelkhand Province.

**Unit – II**

Cuddapah and Vindhyan formations of Peninsular India, Kurnool group, Delhi Super group, Kaladgi and Pakhal Groups, Kolhan Group, Bijawar and Gwalior groups.

**Unit – III**

Description, Critical study and correlation of Palaeozoic rocks of Spiti, Kashmir and salt range- Umaria Marine formation ,Gondwana group - Mesozoic rocks of India. Cretaceous of Trichinopoly formation, Jurassic of Kutch,.

**Unit – IV**

Rise of Himalayas – Eocene – Miocene and Oligocene rocks of Assam, Kerala, Tamilnadu and Pondicherry – Siwalik formations – Karewa formations.

**Unit – V**

Caledonian, Hercynian and Alpine orogenesis in India. Age problem – saline series and Deccan traps, Boundary problems- Pre-Cambrian – Cambrian, Permian- Triassic and Cretaceous – Eocene, Pleistocene glaciations, Ice ages of India.

**Text Book:-**

1. Dunbar, C.O. & Rogers, J. 1961. Principles of Stratigraphy, Wiley.
2. Eicher, L.D. 1968. Geologic time, Prentice Hall.
3. Gignoux, M. 1960. Stratigraphic Geology, Freeman.
4. Krishnan M.S. 1968. Geology of India and Burma, Higginbothams,
5. Wadia D.N. 1953. Geology of India, Macmillian and Co.
6. Pasco E.S. 1968. A manual of the Geology of India and Burma
7. Ravindra Kumar – Fundamentals of Historical Geology and Stratigraphy of India. 2008. New Age International Publishers, 254p.
8. Weller, J.N. – Stratigraphic principles and practice, Harper and Row.
9. Wadia. 1973. Geology of India. McGraw Hill books.



**HYDROGEOLOGY**

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**Objective:** L T P C  
6 0 0 4  
**This paper deals with the ground water hydrology and hydrogeology.**

**Unit -I**

Groundwater in hydrologic cycle. Origin and distribution of water in the earth's crust. Geologic structures favouring ground water occurrence. Hydrostratigraphic units. Groundwater Provinces of India. Classification of aquifers. Hydrological properties of rocks – Porosity, Permeability, Transmissivity, Storagivity, Specific Yield, Diffusivity.

**Unit -II**

Factors causing groundwater movement. Importance of hydraulic gradient. Darcy's law and its application. Groundwater recharge – Methods of artificial recharge Isotopic techniques in dating groundwater. Application of tracers in recharge estimation – use of Tritium and environmental chloride.

**Unit -III**

Field and laboratory techniques of aquifer parameter evaluation through pumping tests – testing schedule – measurements of drawdown and discharge, step draw down and distance – drawdown seepage face pumping tests, data analysis – Theis method non-equilibrium formula, Jacob's method. Theis recovery method and chows method.

**Unit -IV**

Methods of Groundwater exploration - application of Geological and Geophysical techniques. Techniques of groundwater extraction, Drilling techniques and well construction. Groundwater budget estimation – Groundwater models and their role in water management. Chemical characteristics of groundwater in relation to domestic industrial and irrigational uses – Graphical representation of hydrochemical data, Saltwater encroachment in coastal aquifers.

**Unit-V**

Water Pollution, Types of pollution, controlling methods; water purification- settling, coagulation, fluorination, defluorination, disinfection, deodorization, sources of elevated concentration of salts, groundwater basins of Tamil Nadu, Rain water harvesting, Principles of management of water resources, groundwater problems and their management in India.

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**Text Book:-**

1. Todd D.K., 1980. Groundwater Hydrology, John Wiley.
2. Walton V.C. 1970. Groundwater Resource Evaluation.
3. Bouwer, H., 1978. Groundwater Hydrology.
4. Linsley, R.K.Kohler, M.A. & Paulhus, J.L.M., 1975. Applied Hydrology.
5. Davies and De Wiest, 1966. Hydrology.

6. Arul, P., 2000. A Text book of Groundwater, Dhanam Agency, Vridhachalam.

7. Ramakrishna H., 2001. Groundwater.

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**REMOTE SENSING AND GIS (Elective Core)**

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**Objective:**

L T P C  
4 0 0 4

**The paper is about image interpretation in geology and remote sensing.**

**Unit I**

Introduction to remote sensing –Electromagnetic radiation, Electromagnetic spectrum, Interactions with atmosphere, Interaction with target, Recording of energy by sensor, Transmission, reception and Processing, Interpretation and analysis. Sensor systems- Passive and active systems. Sensor resolutions- Spatial resolution, Spectral resolution, Radiometric resolution, Temporal resolution.

**Unit II**

Types of aerial photographs- how aerial photographs are taken- geometry of vertical photographs- scale of aerial photographs-vertical exaggeration-parallax- stereoscopy-pocket and mirror stereoscopes- geological interpretation of aerial photographs-aerial mosaics.

**Unit III**

Interpretation of multispectral imagery, thermal imagery, infrared imagery, and radar imagery. Introduction to hyper spectral remote sensing. Remote sensing satellites- LANDSAT – SPOT- IKONOS- QUICKBIRD – JERS – RADARSAT.

**Unit IV**

Introduction to Geographic Information Systems. Components of GIS- GIS subsystems- GIS data models- GIS data types- Spatial data models- Vector and raster data formats- Attribute data models. Spatial data relationship- Topology. GIS data management- input techniques, data editing and quality assurance, GIS data management.

**Unit V**

**Manipulation and Transformation of spatial data- integration and modeling of spatial data- retrieval, reclassification, topological overlay, neighborhood operations, connectivity analysis. Surface modeling- Digital Terrain Model and Digital Elevation Model. Application of GIS in mapping- geological bodies, groundwater targeting, artificial groundwater recharge, natural resource management and Landuse and Landcover changes.**

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**Text Book:-**

1. Benhardsen, T., 2002. Geographic Information Systems: an Introduction, John Wiley & Sons, New York,
2. Bonham-Carter, G.F., 1994. Geographic Information System for Geoscientists Modelling with GIS, Pergamon Press, Oxford,
3. Davis A.C., 1973. Statistics and data analysis in Geology, Wiley.
4. Durry S.A 1987 Image Interpretation in Geology, Allen and Unwin.
5. Guha, P.K.,2008, Remote Sensing for the Beginner, Second Edition, East-West press pvt.ltd, New Delhi.178 pp.
6. Ian Heywood, Sarah Corrdius and Stevecarver, 2000. An introduction to Geographic Information system. Longman Ltd, Newyork
7. Kang-tsung Chang, 2002. Introduction to Geographic Information system.Mc Graw Hill
8. Lillesand, T.K., 1987. Remote sensing and Image Interpretation.

9. Miller, V.C-1962-Photogeology, McGraw hill.
10. Narayan LRA 2016 Remote sensing and its Applications, Universities Press, 215p.
11. Siegal, B.S and Gillespie, A.B 1980., Remote Sensing in Geology, Jhon Wiley.  
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**ISOTOPE GEOLOGY (Elective Core)**

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L	T	P	C
4	0	0	4

**Unit-I**

**Introduction to Isotope Geology:** Introduction – Basic principles of Isotope Geology – Isotopy - Chemical properties of Isotopes, Thermodynamic properties of Isotopic compounds -Equilibrium constants, separation of isotopes - Physical and chemical methods - Classification of Isotopes - Relationship between radionuclides and its decay products, Units of radioactivity measurement.

**Unit-II**

**Distribution and properties of Isotopes:** Distribution of Radioactive elements in Igneous, Sedimentary and Metamorphic rocks and waters - Study of important unstable isotopes. Distribution of Radioactive mineral deposits in India - Geochemical behaviour of Uranium and Thorium – Natural production - Anthropogenic releases of radionuclides.

**Unit-III**

**Instrumentation and methods of application of radioactive isotopes:** Measurement of radioactivity-Scintillation counters, Mass spectrometer. Isotopic dilution techniques. Geochronometry, Age of the earth, Age of the element, rate and age of deposition, radioactivity and genesis of petroleum. Use of radioactivity in Well logging. Application of environmental isotopes. Fractionation of stable isotopes in lithosphere, Hydrosphere and Atmosphere. Stable isotopes and their uses.

**Unit-IV**

**Stable isotopes and its nature:** Stable isotopes in water cycle - Relation between  $^{18}\text{O}/^{16}\text{O}$  and  $2\text{H}/1\text{H}$  in natural waters –Evaporation, Clouds and Precipitation - marine and continental atmosphere. Isotope effects in precipitation - The latitude / annual temperature effect - Seasonal effect - Oceanic and continental precipitation - Altitude effect - Amount effect - Interannual variations - Small-scale variations - Palaeoclimate reconstruction. Tritium in the atmosphere - Characteristics of tritium - Geophysical aspects - Hydrological aspects. Atmospheric  $\text{CO}_2$  -Atmospheric  $\text{CO}_2$  concentrations - Stable carbon isotopes in atmospheric

CO<sub>2</sub> - Stable oxygen isotopes in atmospheric CO<sub>2</sub> - Radiocarbon in atmospheric CO<sub>2</sub>.  
Water Sampling and Treatment - Water sampling and storage - Laboratory treatment of water samples - 18O/16O analysis - 2H/1H analysis - 3H analysis of water - 14C analysis of dissolved inorganic carbon - 13C/12C analysis of dissolved inorganic carbon.

**Unit-V**

**Tracer techniques in hydrogeology:** Tracers and transports - Types of tracers - Types of tracer experiments – Isotopic tracers. Water Rock Interaction - physical absorption - Chemical absorption - Exchange of ions - Chemical interaction between solutes. Low Temperature System - Unsaturated zone - Geohydraulic aspects - Solute transport– Applications - Saturated zone- Origin of groundwater - Groundwater dating -The radiocarbon dating - 14C standard - natural 14C variations - 14C age determination - Dating groundwater with DIC and DOC - Relation between 13C and 14C variations - Comparison of 3H and 14C variations. High Temperature Systems - Natural processes - Anthropogenic processes.

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**Text Book:-**

1. Henry Faul, 1954. Nuclear Geology, John Wiley & Sons, New York,
2. Kalvero Rankama, 1954. Progress in Isotope Geology, Pergamon press, London.
3. Gaunter Faure,1986. Principles of Isotope Geology, John wiley & Sons, New York, 2<sup>nd</sup> ed.
4. Aswathnarayana, U. 1985. Principles of Nuclear Geology, Oxonian Press(P) Ltd., New Delhi.
5. Rankama and Sahama, 1950. Geochemistry, University of Chicago Press,.
6. Robert D. Nininger, D. 1955. Minerals of Atomic energy, Van Nostrand Co.,
7. Zussman. J, Longmans, 1966.Physical methods in Determinative mineralogy.
8. Virnave, S.N., 1999, Nuclear Geology and Atomic Mineral Resources, Bharati Bhawan Publishers & Distributors,.
9. Sambhar Chaudhui, Isotope Signatures in Sedimentary Records.

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**GEOEXPLORATION (Elective Core)**

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	L	T	P	C
<b>Unit – I</b>	4	0	0	4

**Introduction to Geoexploration:** General principles and methods - prospecting: geological description of outcrops - Reconnaissance geological survey – Detailed geological mapping – Sampling: general principles, methods of sampling, Sampling errors. Geological principles of ore prospecting by Physiographic, lithologic, Stratigraphic, Structural and mineralogical studies.

**Unit – II**

**Concepts in geophysical techniques – I:** Geophysical exploration: Principles, methods, instruments, field procedures, applications and limitations: Gravity and Magnetic methods – Electrical (Self-potential, Induced Polarization and Resistivity) and Electromagnetic methods.

**Unit – III**

**Concepts in geophysical techniques – II:** Seismic methods – Seismic waves – Electrical properties of rocks - Seismic equipments - Principles of reflection and refraction methods, field procedures, interpretation of data.

**Unit – IV**

**Concepts in geochemical exploration techniques:** Geochemical Exploration: Geochemistry in Mineral Exploration – Introduction - Principles of Geochemical Exploration - Geochemical Environment – Geochemical cycle – Dispersion, Mobility, Association and Distribution of elements – Path finder elements - Methods of geochemical exploration:- (a) Lithochemical prospecting (b) Hydrogeochemical prospecting (c) Biogeochemical prospecting (d) Geochemical prospecting models for petroleum and natural gas; Geochemical prospecting in marine environment.

**Unit – V**

**Other methods of geoexploration:** Geobotanical prospecting – Radiometric methods – Well logging methods (electrical logging methods, self potential logging, resistivity logging and Gamma ray logging).

**Text Book:-**

1. Ramachandra Rao, M.B., 1975. Outlines of Geophysical prospecting (A Manual for Geologists), Prasaranga, University of Mysore.
2. Dobrin M.B., 1960. Introduction to Geophysical prospecting, McGraw-Hill Book Co., New Delhi.
3. Mason and Moore, 1985. Principles of Geochemistry, Wiley Eastern Ltd., New Delhi.
4. Hawkes and Webb, H.E. 1965. Geochemistry in Mineral Exploration, Harper and Row Publishers.
5. Parasnis, D.S., 1962. Principles of Applied Geophysics, Methuen & Co., Ltd., London.
6. Eve A.S.and D.A. Keys, 1954. Applied Geophysics, Cambridge University Press.

7. Phillip H. Abelson, 1950, Researches in Geochemistry, John Wiley and Sons.
8. Kearey. P. 1984.An Introduction to Geophysical exploration, M. Books, Blackwell Scientific Publication.

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**Practical III**  
**(Crystallography and Mineralogy and Indian Stratigraphy)**

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L   T   P   C  
0   0   4   4

**Crystallography and Mineralogy**

Study of rock- forming minerals in hand specimen; study of rock- forming minerals in thin sections; optical properties of uniaxial and biaxial minerals- pleochrism, extinction, interference colours and optical angle; calculation of chemical formula of minerals and its plotting; twin laws; anorthite content of plagioclases; 32 classes of crystal symmetry; method of plotting of poles by stereographic projections.

**Indian Stratigraphy**

- Exercises on stratigraphic classification and correlation
- Study of palaeogeographic maps of all the geological periods
- Plotting of physiographic features on maps



**Text Book:-**

1. F.C. Phillips. 1946. An Introduction to crystallography –.
2. Ernest, E.Walstrom, 1960, Optional Crystallography -, John Wiley & Sons,
3. Dana, E.S.1935. A Text Book of Mineralogy-, John Wiley & Sons,
4. Buerger, M.J. 1956. Elements of Crystallography, John Wiley and sons.
5. Mitra.S. 1994. Fundamentals of Optical, Spectroscopic and X-ray Mineralogy, available at S.R.Technico Book House, Ashok Raj Path, Patna. Earth Materials- Introduction to Mineralogy and Petrology, Cornelis Klein and Anthony Philpotts, Cambridge University Press, 2013.
6. Understanding Earth (Sixth Edition), John Grotzinger and Thomas H. Jordan, 2010, W.H. Freeman and company, New York.



**Practical IV**  
**(Hydrogeology and Elective Core Remote Sensing and GIS)**

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L   T   P   C  
0   0   4   4

**Hydrogeology**

Delineation of hydrological balance on water – table contour maps and estimation of permeability; analysis of hydrographs; geophysical and geological methods of ground water exploration; pumping test; time draw down and time recovery tests and evaluation of aquifer parameters; step drawdown tests; estimation of TDS using resistivity and SP logs; electric resistivity sounding for delineation of fresh and saline aquifers

**Remote Sensing and GIS**

Study and nature of aerial photographs resolution, mosaics, symbols, gully, pattern and drainage analysis, image parallax; determination of scale, height, dip, slope, vertical exaggeration and image distortion; detailed study of imageries.

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**Text Book:-**

1. Miller (1961): - - Photogeology.
2. Sabbins (1985): - Remote Sensing- Principles and Applications
3. Ray (1969): - Aerial Photographs in Geological Interpretations 4. Drury (1987): - Image Interpretation in Geology
4. Todd, D.K. (1980): -Groundwater Hydrology
5. Davies, S.N and De Wiest, R.J.M (1966): - Hydrogeology
6. Freeze, R.A. and Cherry, J.A. (1971): -Groundwater
7. Fetter, C.W. (1990): -Applied Hydrology

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**IGNEOUS PETROLOGY**

	L	T	P	C
<b>Objective:</b>	6	0	0	4

**To understand the forms, structures and textures of the intrusive nature of the igneous rocks, Crystallization, classification and petrogenesis of igneous rocks.**

**Unit -I**

Forms, structures and textures of igneous rocks and their significance- classification of igneous rocks - mineralogical and chemical, C.I.P.W, Niggli, Tyrrel, IUGS and Rosenbusch.

**Unit -II**

Application of physical chemistry in petrogenesis-phase rule and equilibrium in silicate system - consolidation of magma with binary systems and ternary systems - crystallization of two component systems diopside – anorthite system, alibite-anorthite system, leucite - silica system, and crystallization of three component systems Alibite - anorthite – diopside system, Anorthite – forsterite - silica system, Diopside-forsterite-silica system Nepheline-kalsilite-silica system and Anorthite-leucite-silica system.

**Unit -III**

Crystallization of Magma with Particular Reference to Basaltic Magma-Reaction Principle-Diversity of Igneous Rocks - Petrographic Provinces-variation diagrams.

**Unit -IV**

Petrography and Petrology – Granite clan, Syenite clan, Gabbro clan, Lunar rocks, Ultrabasic and Ultramafic rocks, Peridotite, Dunite, Lamprophyre, Pegmatite, Aplite, Basalt, Spillite and Keratophyre.

**Unit -V**

Petrogenesis of Granite, Pegmatites, Alkaline rocks, Anorthosites, Carbonatites, Charnockite, Ultrabasic rocks and Lamprophyres.

**Text Book:-**

- 1.Tyrrel,G.W,1963 Principle of petrology. Methunn&co
- 2.Turner,F.J,Verhoogen,J.1960-Igneous and Metamorphic petrology, McGraw Hill Co,Newyork.
- 3.Bowen,n.l.,1968 -Evolution of igneous rocks dover publication.
- 4.Huang,T,1962-Petrology McGraw hill book.Co .,

5. Hatch, F.E, Wells, A.K and Wells, M.K, 1949- Petrology of igneous rocks, Thomas Mury and co.

6. Hyndman, Donald, 1972- Petrology of Igneous and Metamorphic rocks,mcgraw hill book co.

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**SEDIMENTARY PETROLOGY**

**Objectives :**

L	T	P	C
6	0	0	4

To become familiar with the petrographic nomenclature of sedimentary rocks. To learn about the occurrence, origin, classification and environments of sedimentary rocks.

**Unit -I**

The texture of sediments-size, shape and roundness, porosity and permeability. textures of non - clastic sediments – the mechanical and chemical structures of sedimentary rocks-classification of sedimentary rocks - graban, krynine, pettijohn and Goldschmidt.

**Unit -II**

Study of important clastic and non-clastic rocks, sandstones, classification.terminology, chemical composition, origin of chemical cements. Mud rocks - mineral and chemical composition, sedimentary structure, compaction of mud rocks and porosity.

**Unit -III**

Mineralogy, carbonate frame work, Organic matter, Limestone, sedimentary structures. Diagenetic process. Sedimentary classification of limestone. Dolomite –primary and secondary mechanism of dolomitisation, dedolomitisation. Evaporites and native sulphur. Chert-texture, genesis and origin. Phosphates-mineralogy and genesis.

**Unit -IV**

Concept of sediment size and grade scale - principles of mechanical analysis, parameters of the frequency distribution of sediments-median, mode,mean,sorting velocities of small particles-stoke’s law. Porosity and permeability and their determination in sediments. Measurement of roundness and sphericity and their significance.

**Unit -V**

Methods of heavy minerals separation and their significance in sediments-sedimentary environments and facies-diagenesis and lithification-physical and chemical factors in sedimentation.

**Text Book:-**

1. Blatt H, Middleton, Grand Murray.R, 1972.Origin of sedimentary rocks, Prentice Hall.
2. Carver,R.E.197. Procedures in sedimentary petrology, Inter Science.
3. Folk.F.L., 1968.Petrology of sedimentary rocks Hempill’s University station Texas,.
4. Krumbein W.C.and Pettijohn F.J. 1938, Manual of sedimentary petrology, Appleton Century co.
5. Pettijohn F.J.,Potter,p.e. 1972.Silver.r.sand and stones. Springer-Verlag.
6. Pettijohn F.J. 1857. Sedimentary rocks.harper&row,.
7. Selley R.C. 1972. Ancient sedimentary environments Corwell University press.

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6	0	0	4

**UNIT I**

**Introduction to Research:** Definition – scientific Method – Bias and Prejudice in scientific research – Hypothesis, theory and scientific Law – Research design – Preparation of research project – Report writing.

**UNIT II**

**Thesis Writing:** Structure of thesis - Copyright waiver- Declaration - Title page - Abstract - Acknowledgments - Table of contents - Introduction - Literature review - Materials and Methods - Theory - Results and discussion - Conclusions and suggestions for further work – Summary - References – Bibliography - Footnotes and endnotes and appendices

**UNIT III**

**Field Work in Geology:** Field instruments (Geological Rock Hammer, Brunton, GPS, Altimeter, pedometer), Essentials of topographic and geological maps and mapping - pre-requirements and sampling of geological specimens (fossils, rocks, oriented rocks, groundwater and unconsolidated sediments), measurements of structural features in rock types – bedding, lineation, foliation, fold, fault, shear zone and unconformity.

**UNIT IV**

**Instrumentation:** General principles, description and uses of following: Polarizing microscopes, ore microscopes, Scanning Electron Microscope, mirror stereoscope, heavy mineral separators (mechanical and electromagnetic). Analytical instruments: General principles, description and uses of following; XRF, XRD, Atomic Absorption Spectrophotometer, Electron Probe Micro Analyzer, Inductively Coupled Plasma – MS.

**UNIT V**

**Geological Laboratory Procedures:** Maceration techniques, thin section making, induration techniques for unconsolidated sediments, tracers, staining techniques for feldspar identification - Construction and use of wind rose, fence diagram, Wolf’s net, equal area, trilinear diagram.

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**Text Book:-**

1. Phillips, E.M and Pugh, D.S., 1994. 'How to get a PhD: a handbook for students and their supervisors'. Open University Press, Buckingham, England.
2. Tufte, E.R., 1983. 'The visual display of quantitative information'. Graphics Press, Cheshire, Conn.
3. Mishra R.P., 1989. Research Methodology. Concept Publishing Co, New Delhi..
4. Compton R.R., 1962. Manual of field geology, Wiley.
5. Lahee H., 1959. Field geology, McGraw-Hill.

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**APPLIED GEOLOGY (Core Elective)**  
**(Geophysics and Geochemistry, Engineering, Mining Geology and Ore Dressing)**

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L   T   P   C  
4   0   0   4

**Unit I**

**Geophysics** – Definition – Subsurface exploration – Interrelationship between geology and geophysics - Geophysical methods – Types of measurements – exploration based on electrical resistivity method – Instrumentation and field Procedure – electrode arrangement of different configuration – VES – Fundamentals of seismic prospecting - Seismic studies– field procedure – Data interpretation. Principles of gravity method-gravimeter- field surveys and interpretation. Magnetic studies – Instrument for magnetic survey – field procedure – data interpretation.

**Unit-II**

**Geochemistry:** Definition, aims and scope, geochemical structure and composition of the earth. Different hypothesis about core, mantle and crust. Distribution of elements in the geospheres. Geochemical affinity. Geochemical classification of elements. Geochemistry of geospheres, lithosphere, hydrospheres, biosphere and atmosphere. Exogenic Cycle – Sedimentation – Principles – Process – Products of Weathering. Geochemical Classification of Sediments.

**Unit-III**

**Engineering Geology:** Role of engineering geology in civil construction and mining industry various stages of engineering geological investigation for civil engineering projects like Dam, Reservoir and Tunnel. Engineering properties of rocks, properties of building stones - soil physical and engineering properties of soils - classification of soil and soil groups of India.

**Unit-IV**

**Mining Geology:** Prospecting, Sampling and evaluation of ore resources. Definition of terms – Open cast and underground mining. Alluvial mining, Underground mining methods, Coal mining methods, Room and Pillar method, Longwall advancing Long wall retreating, Horizon mining , Underground hydraulic mining and strip mining.

**Unit –V**

**Ore Dressing:** General Principles- Size reduction, Rod mills, Ball mills and Tube Mills. Screening. Principles of Magnetic separation and electrostatic separation. Floatation –

Beneficiation of some important metals: Copper – Aluminium – Iron – Gold – Manganese – Titanium – Zinc – Lead.

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**Text Book:-**

1. Dobrin M.B., and Savit C.H.,1988. Introduction to Geophysical Prospecting (4th ed.,) McGraw – Hill, New York.
2. Parasnis D. S .1997, Principles of applied geophysics, Chapman & Hall, 2-6 Boundary Row, London SE1 8HN, UK.
3. Ramachandra Rao, M.B., Prasaranga, 1975. Outlines of Geophysical Prospecting - A manual for geologists by University of Mysore, Mysore,.
4. Telford, W.M. Geldart, L.P. and Sherriff, R.E., 1990. Applied Geophysics, 2nd Ed, Cambridge University Press, Cambridge, 770 pp.
5. Kruskopf.E.B. 1967. Introduction to geochemistry, mcgraw, hill.
6. Brian mason, 1966.principles of geochemistry,willey
7. Brounlow,A.N. 1979.Geochemistry,prentice hall.
8. Richards R.H.and C.E. Lecke, 1927. Hand book of ore dressing , Mc.Graw Hill Book co.
9. Gaudin A.M., 1939. Principles of mineral dressing , Mc – Graw Hill Book co.
10. Truscott S.J. 1923– Text book of ore dressing , Macmillan co.
11. Gohahle and Rao, T.C. 1972. ore deposits of India – Thosman Press India ltd.
12. Krynine and Judd – Principle of Engineering Geology and Geotechniques.
13. Valdiya, K.S. 1987.Environmental Geology - Indian Context, Tata – McGrawhill New Delhi.1977.
14. Arogyaswamy , R.N.P. 1996. Courses in mining geology , Oxford & IBH – Publishers.



**SOCIAL GEOLOGY (Core Elective)**

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L	T	P	C
4	0	0	4

**Unit -I**

**Geological Heritage:** Needs to protect-measures of conservation-brief description of any five geological heritage localities of India-Geological organizations of India - Role of geologist in Nation building - Case histories of people’s movement to protect land and water.

**Unit -II**

**Water Resources:** Interlinking of Rivers-Surface water and Groundwater Budget-Groundwater Borewell Strategies for Optimal Use-Groundwater borne diseases and mitigation measures- quality standards for potable water – Ground water exploitation by industries and its social implications: conservation and conjunctive use – Rainwater harvesting.

**Unit -III**

**Disaster Preparedness:** Personal, private and public precautions and safety measures to be observed before, during and after geological events such as earthquakes – tsunamis – landslides - caving and fire in petroleum and coal fields.

**Unit -IV**

**Social Implication of Mining:** Environmental issues concerning mineral mining - geological and social effects of river sand abstraction-Rehabilitation of local populace of mine area-Land reclamation-mining waste disposal.

**Unit -V**

**Mineral Economics:** National Mineral Policy-Mineral wealth of India-Mining laws-minor and major minerals-mineral royalties - Geological modification due to developmental activities-coastal regulation.

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**Text Book:-**

1. Knell, S.J., 2000.The Culture of English Geology, 1815-1851:A Science Revealed Through its Collecting.UK:Ashgate,400pp.
  2. Prasad, K.N., 2006.An Introduction to Earth Science: Heritage Site. A.P.H.Publishing Corporation.
  3. Bell. F.G. 1998. Environmental Geology Principles and Practice. Blackwell science. Oxford.597.
  4. Rowe. R.K. Geotechnical and geoenvironmental engineering handbook . Ed. R.K. Edition. U.S.A.
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L	T	P	C
4	0	0	4

**Unit – I**

**Introduction to Nanogeoscience:** Introduction – Definition – Applicable fields of study – Types and environment of nanoparticles – Natural and anthropogenic inputs – Size – dependent stability and reactivity of nanoparticle – Benefits – Risks – Remediation.

**Unit – II**

**Nano-mineralogy:** Nanocrystal – Transformation of nanoparticle structure – Nanoparticle growth – surface impurities – Biomineralization: microbial biomineralization – Nanostandard materials.

**Unit – III**

**Nanosystems:** Mineral-water-bacteria – Biomimetic Soils and sediments – Atmospheric particulates- Carbon cycle – Organic-Inorganic Nanoparticle Interactions in sedimentary systems – Magnetic nanomaterials – Biogenic magnetite – Zeolites,Clays, Fe-Ti oxides, and phosphate minerals.

**Unit – IV**

**Nanotechnology:** Brief principles and description of :calorimetry, UV visible Infra-Red, Raman and NMR spectroscopy,Scanning electron microscopy (SEM) Atomic Force Microscopy, Electron Microprobe and High-Resolution Transmission Electron Microscopy – Definition and applications of nano-satellites and micro-satellites.

**Unit -V**

**Nanomaterials:** Properties at the nanoscale – Categories: Metal and Ceramic Nanopowders,Carbon Nanotubes and Nanospheres, Nanowires, Quantum Dots, Dendrimers, Protein and Structured Polymer Strands – Nanometrology – Dispersions – Top-down and Bottom-up methods.

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**Text Book:-**

1. Andersen, M.M. and Rasmussen, B., 2006. Nanotechnology development in Denmark- environment opportunities and risk. Riso National Laboratory, Denmark.
2. Chemical Industry R&D Roadmap for Nanomaterials By Design: From Fundamentals to Function,2003. www.ChemicalVision2020.org.
3. Cientifica,2003."The Nanotechnology Oppurtunity Report",2nd Edition, Executive Summary. CMP Cientifica,2002."Nanotechnology" The Tiny Revolution.
3. Nartikar.Y.Y. Fu. 2010.Hand book. Nanoscience and Technology.
4. Muralidharan. V.S. M 1998. Nanoscience. Alagappa Chettiar College of Engineering technology.

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**PRACTICAL V**  
**(Igneous and Sedimentary Petrology)**

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L	T	P	C
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- Megascopic and microscopic study of different igneous and Sedimentary rocks.
- Petrochemical calculations CIPW Norm, Variation diagram of Harker, Niggli.

**PRACTICAL VI**  
**(Research Methodology and Elective Core- Applied Geology)**

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L	T	P	C
0	0	4	4

- Problems related to Research Methodology, Engineering geology, Mining geology, ore dressing, / Social geology/ Nano geoscience.
  
- Calculation of Ore reserve estimation.

**METAMORPHIC PETROLOGY**

**Objectives :**

**L T P C**  
**6 0 0 4**

**To become familiar with the petrographic nomenclature of metamorphic rocks. To learn about the kinds, textures and structures, zones, grades and facies, occurrences and stability of metamorphic mineral assemblages.**

**Unit-I**

Agents and kinds of metamorphism, the Gibbs Phase Rule and Goldschmidt’s mineralogical phase rule.

**Unit-II**

Classification of metamorphic rocks. Metamorphic textures and structures. Metamorphic grades and zones concepts-depth zones, contact metamorphic zones, Barrowian zones, Buchan zones, Sanbagawa zones, Franciscan zones, Dharwarian zones. Paired metamorphic belts.

**Unit-III**

Concept of metamorphic facies.facies classification of metamorphic rocks.Views of Eskola, Winkler, Turner and Verhoogen. Graphical representation of facies diagrams - ACF and AKF diagrams. Metamorphic differentiation. Metasomatism, Granitisation.

**Unit-IV**

Thermal, cataclastic ,and regional metamorphism and their effects on carbonates,argillaceous,arenaceous and acid ,basic and ultrabasic igneous rocks. Retrograde metamorphism.

**Unit-V**

Migmatisation, Charnockitisation, Palingenesis, Origin of Eclogites, origin of Amphibolites metamorphism In relation to plate tectonics, Magmatic emplacements and orogenesis.

**Text Book:-**

1. Tyrrell, G.W. 1963. Principles of Petrology, Methunn, Co.
2. Winkler H.G.F. 1974. Petrogenesis of Metamorphic rocks, Third Edn. Springer Verlag.
3. Turner F.J. 1968. Metamorphic Petrology, McGraw Hill.
4. Miyashiro, A. 1973. Metamorphism and metamorphic belts Allan and Unwin.
5. Hyndman, F.D. 1972. Petrology of Igneous & Metamorphic rocks McGraw Hill.
6. Bhaskar Rao,1986, Metamorphic petrology, International Book house, Second ED,m 12. Bangalow Road, Delhi- 110 007.Williams, H ,F.J Turner and C.M., Ghilbert, 1954, Petrography. W.H. Freeman and Co.,
7. Winkler, H.G.S. 1979. Pertogenesis of Metamorphic rocks, Springer Verlag Vth ed.

**ECONOMIC GEOLOGY AND MINERAL ECONOMICS**

**Objectives :**

L T P C  
6 0 0 4

To learn about geology of the non metallic minerals and their industrial applications, distribution and mode of occurrences. To gain knowledge about the mines legislation of India, National mineral policy, and their role in National economy.

**UNIT-I**

Concept - Scope of study- Peculiarities In mineral industry - A brief outline of World's mineral resources including marine origin. Mining laws - major and minor minerals - royalty on minerals- an overview of the mines and minerals (regulation and development) act. Tenor, grade and specification of ores.

**Unit II**

Strategic, critical and essential minerals - classification of minerals from military point of view - Mineral conservation and substitution - Outline of National Mineral policy. Process of formation of mineral deposits; Magmatic concentration – Contact metasomatism- Hydrothermal processes- Metasomatic replacement – Sedimentation- Evaporation – Residual and mechanical concentration – Oxidation and supergene enrichment – Metamorphism.

**Unit III**

Controls of ore localization, Mineral paragenesis and zoning, Geothermometry, geobarometry, paragenetic sequence, zoning and dating of ore deposits. Features, structures of ore and gangue minerals. Fluid inclusions, wall rock alteration. Metallogenic Epochs and Provinces – Geologic setting and genesis of the following Indian mineral deposits. Iron, Manganese, Chromium, Nickel, Cobalt, Vanadium, Molybdenum, Tungsten, Copper, Lead, Zinc, Tin, Gold, Silver, Aluminium, Magnesium, Titanium, Uranium, Thorium, Mineral wealth of Tamilnadu and Pondicherry.

**Unit IV**

Minerals used in the manufacture of cement, Abrasives, Precious and semi-precious minerals, Refractories, Metallurgical, Fertilizer, Building Industries, Ceramics, Glass, Chemicals, Paints and Pigments and Insulators – Mineral water and Ground water.

**Unit V**

Ore microscopy – The ore microscope, Preparation of polished surface of ores, Physical and optical properties of ore mineral, microchemical techniques and applications of ore microscopy. Techniques of investigations in ore mineragraphic studies.

**Text Book:-**

1. Bateman. A.M. Economic mineral deposits, John Wiley & Sons
2. Krishnaswamy. S . 1972. India's Mineral Resources, Oxford and IBH Publishers New Delhi
3. Gokhale and Rao Ore deposits of India, Thompson press, New Delhi.
4. Sinha, R.K., Sharma, N.L., 1976- Mineral economics. second edition , oxford & ibh publication co. New Delhi, 368pp.
5. Krishnaswamy, S., - 1971 – Indian Mineral Resources, oxford & ibh publishing co., New Delhi.
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Delhi.

**Practical VII**  
**(Metamorphic Petrology and Economic Geology and Mineral Economics)**

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	L	T	P	C
<b>Metamorphic Petrology</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>4</b>

- Study of metamorphic rocks in hand specimen;
- Study of metamorphic rocks in thin sections;
- Structures and textures in metamorphic rocks;
- Interpretation of reaction texture;
- Plotting of chemical data on ACF, AKF and AFM diagrams;
- Preparation of metamorphic rock slides.

**Economic Geology and Mineral Economics**

**Identification and description of the following economic minerals:**

Magnetite, Ilmenite, Hematite, Pyrite, Pyrolusite, Psilomelane, Chromite, Wulframite, Chalcopyrite, Malachite, Galena, Magnesite, Bauxite, Stibnite, Cinnabar, Gypsum, Barite, Monazite, Rutile, Sillimanite, Kyanite, Corundum, Calcite, Dolomite, Beryl, Asbestos, Orpiment.



**PRACTICAL VIII**

**(Viva Voce on Mapping, Field Training, Industrial Training and Short Field Trips)**

	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
Viva Voce on	<b>0</b>	<b>0</b>	<b>4</b>	<b>4</b>
➤ Geological mapping (Ten days)				
➤ Geological tour more than three weeks days				
➤ Short field trips				
➤ Industrial/In plant training and Specimen collection				
➤ Specimen collection and short field trips				
➤ All Reports submission				

**Project Viva Voce**  
**(Viva Voce on Mapping, Field Training, Industrial Training and Short Field Trips)**

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<b>Project evaluation and Viva Voce</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>10</b>	<b>0</b>	<b>0</b>	<b>8</b>

The Project Oriented Dissertation must be submitted by the end of fourth Semester with a Viva Voce before the faculty members and the board of examiners for the purpose of evaluation. During the course of completion of the Dissertation work the students will be required to complete various assignments given to them by their respective supervisors for the purpose of their evaluation. The Dissertation shall be of 4 credits out of which 8 credits (50 marks) will be evaluated by the Board of Examiners through a presentation and Viva-Voce examination while 4 credits (50 marks) will be evaluated by the respective supervisor.