

# Yogi Vemana University

5 year M.Sc., Integrated Course w.e.f 2018-19  
Earth Science

## Semester - I

Paper No.	Title of the Paper	Teaching Hours per week	Marks	Credits
16011	Second Language -Telugu	4	100	4
16012	Introduction to Biology	4	100	4
16013	Mathematics-I	5	100	4
16014	Physical Sciences-1	4	100	4
16015/16025	Cell Biology / Earth & Atmospheric Sciences	4	100	4
16011P	Biology Lab	3	100	4
16012P	Physics Lab-I	3	100	4
16013P	Chemistry Lab-1	3	100	4
	Total	30	800	32

## Semester - II

Paper No.	Title of the Paper	Teaching Hours per week	Marks	Credits
26011	English	4	100	4
26012	Computer Science-I	4	100	4
26013	Mathematics-II	5	100	4
26014	Physical Sciences – II	4	100	4
26025	<b>Geomorphology</b>	4	100	4
26011P	Computer Science Lab-I	3	100	4
26012 P	Physics Lab-II	3	100	4
26013 P	Chemistry Lab-II	3	100	4
	Total	30	800	32

## Semester - III

Paper No.	Title of the Paper	Teaching Hours per week	Marks	Credits
36011	Communication Skills (English)-I	5	100	4
36012	Computer Science-II	4	100	4
36013	Mathematics and Statistics	6	100	4
36014	Physical Sciences – III	4	100	4
36025	<b>Crystallography &amp; Mineralogy</b>	4	100	4
36011P	Computer Science Lab II	3	100	4
36012 P	Physics Lab-III	3	100	4
36013 P	Chemistry Lab- III	3	100	4
	Total	32	800	32

### Semester - IV

Paper No.	Title of the Paper	Teaching Hours per week	Marks	Credits
46011	Communication Skills (English)-II	4	100	4
46012	Environmental studies	4	100	4
46013	Principles of Management & Entrepreneurship	4	100	4
46014	Introduction to Bio informatics	4	100	4
46024	Computer Application in Earth Sciences			
46025	<b>Optical Mineralogy</b>	4	100	4
46011P	Communication Skills Lab	3	80	4
46012P	Microbiology & Introduction to Bio informatics	3	80	4
46022P	Computer Application in Earth Sciences Lab			
46023P	<b>Crystallography, Mineralogy and Optical Mineralogy Lab</b>	3	80	4
46021S	<b>Seminar</b>	3	60	4
	Total	32	800	36

### Semester - V

Paper No.	Title of the Paper	Teaching Hours per week	Marks	Credits
56021	Igneous Petrology	4	100	4
56022	Metamorphic Petrology	4	100	4
56023	Sedimentology	4	100	4
56024	Structural Geology	4	100	4
<b>56025</b>	Geochemistry	4	100	4
56021P	Igneous & Metamorphic Petrology Lab	3	80	4
<b>56022P</b>	Sedimentology & Structural Geology Lab	3	80	4
56023P	Geochemistry Lab	3	80	4
56021S	<b>Seminar</b>	3	60	4
	Total	32	800	36

### Semester - VI

Paper No.	Title of the Paper	Teaching Hours per week	Marks	Credits
66021	Hydro Geology	4	100	4
66022	Stratigraphy and Indian Geology	4	100	4
66023	Geotectonics	4	100	4
66024	Paleontology	4	100	4
66025	Geophysical Exploration	4	100	4
66021P	Hydro Geology Lab	3	80	4
<b>66022P</b>	Stratigraphy & Paleontology Lab	3	80	4
66023P	Geophysical Exploration Lab	3	80	4
66021S	<b>Seminar</b>	3	60	4
	Total	32	800	36

### Semester – VII

Paper No.	Title of the Paper	Teaching Hours per week	Marks	Credits
76021	Ore Genesis and Mineral Deposit	4	100	4
76022	Mining and Ore- Beneficiation	4	100	4
76023	Aerial Photography & Photogrammetry	4	100	4
76024	Field Geology & Surveying	4	100	4
76025	Elective-1: Marine Geology/Oceanography	4	100	4
76021P	Economic Geology & Ore Reserves Estimation Lab	3	80	4
<b>76022P</b>	Areal Photography & Photogrammetry Lab	3	80	4
76023P	Mine planning and Survey Lab	3	80	4
<b>76021S</b>	Seminar Presentation & Field Work	7	60	4
	Total	36	800	36

### Semester - VIII

Paper No.	Title of the Paper	Teaching Hours per week	Marks	Credits
86021	Satellite Remote sensing	4	100	4
86022	Digital Image Processing	4	100	4
86023	Environmental Geology	4	100	4
86024	Geospatial Technology, GNSS & Digital Cartography	4	100	4
86025	Elective-2: Petroleum Geology/Fuel Geology	4	100	4
86021P	Remote Sensing lab	3	80	4
<b>86022P</b>	Digital Image Processing Lab	3	80	4
86023P	Geospatial Technology, GNSS & Digital Cartography Lab	3	80	4
<b>86021S</b>	Seminar Presentation& Field Work	7	60	4
86026	Non core -I, Fundamentals of Earth Sciences (CBCS)	4	100	-
	Total	36	800	36

### Semester - IX

Paper No.	Title of the Paper	Teaching Hours per week	Marks	Credits
96021	Engineering Geology	4	100	4
96022	Natural Resource Exploration	4	100	4
96023	Elective-3: Precambrian Geology/Dimensional & Decorative stones	4	100	4
96024	Elective-4: Watershed Management/Disaster Management/ Quaternary Geology	4	100	4
96025	Elective-5: Geoinformatics applications in soil, forestry Environment and agriculture /Mineral Economics	4	100	4
<b>96021P</b>	Engineering Geology & Natural Resource Exploration Lab	3	80	4
<b>96021T</b>	Project Design	3	80	4
<b>96021S</b>	Seminar Presentation& Fieldwork	7	40	4
<b>96026</b>	Non Core-II: Disaster Management	4	100	-
	Total	32	700	32

### Semester – X

Paper No.	Title of the Paper	Teaching Hours per week	Marks	Credits
06021	Research Methodology	4	100	4
06021T	Project/Dissertation	32	300	8
	Total	36	400	12

**\*Weekend field trips VII to X Semesters**

**\*\* Study tour for 10 to 14 days for VIII and X Semester Students**

Semester	Number of Papers	Marks in the Semester End Examinations for each Paper	Internal Tests for Each Paper	Total Marks for all the Papers
I	Theory:4 Physical Sciences I Practicals:3	75 70 100	25 30 -	100x4=400 100x1=100 100x3=300
II	Theory:4 Physical Sciences II Practicals:3	75 70 100	25 30 -	100x4=400 100x1=100 100x3=300
III	Theory:4 Physical Sciences III Practicals:3	75 70 100	25 30 --	100x4=400 100x1=100 100x3=300
IV	Theory:5 Practicals:3 Seminar	75 80 ---	25 -- 60	100x5=500 80x3=240 60
V	Theory:5 Practicals:3 Seminar	75 80 ---	25 -- 60	100x5=500 80x3=240 60
VI	Theory:5 Practicals:3 Seminar	75 80 ---	25 -- 60	100x5=500 80x3=240 60
VII	Theory:5 Practicals:3 Seminar	75 80 ---	25 -- 60	100x5=500 80x3=240 60
VIII	Theory:5 NonCore I Practicals:3 Seminar	75 75 80 ---	25 25 -- 60	100x5=500 100x1=100 80x3=240 60
IX	Theory:5 NonCore II Practicals:1 Project Design Seminar	75 75 80 --- ---	25 25 --- 80 40	100x5=500 100x1=100 80x1=80 80x1=80 40
X	Research Methodology Project (Individual) Viva Voce	100 150 50	--- 100 ---	100x1=100 250 50
<b>Total</b>				<b>7500      200*</b>

# **SEMESTER I**

## **16025 - EARTH AND ATMOSPHERIC SCIENCES**

### **UNIT I**

Exploring the Universe- The Solar System. Theories on the origin of the Earth. Planetary motion: Kepler's Law, Earth as a Planet – its Shape, Size and Density – Movements and their effects, Interior and Age, Geological Time Scale (GTS).

### **UNIT II**

Introduction to Evolution of Continents and Ocean Basins and their permanence – Theories of Paleo-Magnetism - Ice Ages and their Periodicity – Rift Valleys and their characteristics and origin.

### **UNIT III**

Concepts of Latitudes and Longitudes, Mathematical location of places on the globe, Atmosphere – Circulation, Planetary and local winds: Jet streams, Monsoons, EL-Nino and LA Nina phenomena, Inter Tropical Convergence Zone (ITCZ) and The Air - Masses- Cyclones and Anti Cyclones

### **UNIT IV**

Major Natural regions of the World : Hot-Wet Equatorial, Tropical Monsoon and Marine, Savannas, Hot and Mid Latitude Deserts, Mediterranean, Steppes, China Type, British Type, Siberian, Laurentian and Polar.

#### **Text Books:**

1. Physical Geology - A.N. Strahler , 1980
2. Environmental Geosciences - A.N. Strahler and A.H. Strahler, 1973
3. An Introduction to Earth and Environment - A.K. Sinha, 1990

#### **Reference Books:**

1. Elements of Meteorology - Albert Miller and Jack C. Thompson
2. Basic Physical Geology - E. S. Robinson , 1982
3. Certificate Physical and Human Geography- Goh Cheng Leong

# SEMESTER II

## 26025 - GEOMORPHOLOGY

### UNIT I

Nature ,definition, scope , fundamental concepts and Principles in Geomorphology- Geomorphic classification of Land forms – Evolution of various Land Forms- Drainage Pattern- Geomorphic Cycle and their interpretation. Rocks- Origin – Classification – Distribution

### UNIT II

Earth Movements – Epeirogenic and Orogenic Earth movements- Theories of Continental Drift – Isostasy and Plate tectonics – Earth Quakes - Volcanoes and their distribution.

### UNIT III

Geomorphic agents and processes – Weathering – Erosion –Mass wasting –Cycles of erosion Concept – Land forms of Sea – Marine deposits – Coral reefs- Lacustrine deposits- Earth's Heat Budget and Global Climate Change.

### UNIT IV

Geomorphic processes – Erosional and Depositional Land forms made by Fluvial, Glaciers , Aeolian, Karst topography and Seas and Oceans.

### Text Books:

- |                                 |                 |
|---------------------------------|-----------------|
| 1. Text Book of Geomorphology   | - A.L.Bloom     |
| 2. Principles of Geomorphology  | -W.S. Thornbury |
| 3. A text Book of Geomorphology | - P.Dayal       |
| 4. Indian Geomorphology         | - H.S. Sharma   |

# SEMESTER III

## 36025 - CRYSTALLOGRAPHY AND MINERALOGY

### UNIT I

Definition of Crystal –Amorphous and Crystalline states-Morphology of Crystals- Face, Edge, Solid angle, Interfacial angle – Forms of crystals- Symmetry- Parameters – Crystallographic notation – Miller Index-

### UNIT II

Classification of Crystals into 7 systems- Morphological characters of 7 crystal systems- Twin Laws - Twinning in Crystals.

### UNIT III

Definition of Mineral –Classification of Minerals – Rock forming and Ore forming minerals , Physical properties of minerals– Magnetic properties- Electrical properties –Pyro and piezo-electricity ; Modes of mineral formation- Occurrence and association of minerals – Chemical properties of minerals- Isomorphism –Solid solution- polymorphism- Allotrophy- Pseudomorphism- Radio activity- Silicate structures

### UNIT IV

Study of physical and chemical properties and mode of occurrence of the following mineral groups : Nesosilicates, Sorosilicates, Cyclosilicates, Inosilicates, Phyllosilicates and Tektosilicates

### Text Books:

- |                                |                            |
|--------------------------------|----------------------------|
| 1. A Text Book of Mineralogy   | - E.S.Dana                 |
| 2. Elements of Crystallography | - F.A.Wade and R.B.Mattrox |
| 3. Elements of Mineralogy      | - Rutleys                  |
| 4. Rock forming silicates      | - Dear,Jushman, Housis.    |



# **SEMESTER IV**

## **46024: COMPUTER APPLICATIONS IN EARTH SCIENCE**

### **Unit I**

Introduction : History, Scope, Reference Systems, Data formats, Open Source Software. Toposheets and Open Series Maps of India

### **Unit II**

AutoCADD : Introduction - Configuring the system - Template - AutoCAD window - Function Keys - Pull down Menu Bar - Dialog Box - Tool Bars - Palettes - Drawing, Selecting and Editing Commands: Line, Circle, Rectangle, Polygon, Ellipse, Donut, Point, Array, Arc, Polyline and Bloks. Drafting Settings - Layers - Object Snap - Units and Precision - Break - Trim - Extend - Move - Explode - Copy - Mirror - Fillet - Chamfer - Hatch - Gradient Fill. Text and Text Editing - Coordinate Input - UCS & Polar Coordinates, Tracking and Snap - Scale - Stretch - Rotate. Page Setup - Scale - Paper Space - Basic Plotting.

### **Unit III**

Installation, Introduction, Menu Bar Tool Bar, Grid files, menu surface plot and Interpolation. Introduction to Grid , Gridding Methods, Contour Mapping and 3Dviews , Overlays and individual maps

### **Unit IV**

Open source Geospatial Data, Web Geoportals, Exploration and Data download

## 46025 - OPTICAL MINERALOGY

### UNIT I

Principles of optics –Polarizing Microscope-Theories of Light- Refringence- Birefringence- Plane polarized Light- Crossed polarized light- Double refraction-Snell's Law- Index of Refraction- -Dispersion-Critical angle- Total Reflection. Quartz wedge, Mica plate, Gypsum plate

### UNIT II

Interference Colors- Determination of Retardation with Berek Compensator –Extinction- Elongation- Anomalous interference-Formation of Interference Figures- Biaxial Interference Figures- Optical ellipsoids-Fresnel's and Fletcher indicatrix- Dispersions – Optical anomalies

### UNIT III

The Axial Angles  $2E$  and  $2V$  variation in Axial Angle –Determination of optical sign of a Biaxial Mineral-The Optic-Axis Figure- Dispersion in Biaxial Interference Figures-The Universal Stage adjustment, Orientation with the Universal stage- Location of the Uniaxial Optic Axis.

### UNIT IV

Optical Directions in Biaxial Crystals – Illustrative mounts – Illustrative exercise- Stereographic Net – Color and Pleochroism- Optical properties of important minerals – Uniaxial minerals – Calcite, Dolomite, Beryl, Apatite, Corundum, Quartz, Zircon. Biaxial minerals - Gypsum, Albite, Barite, Olivine, Orthoclase, Muscovite, Hypersthene, Kyanite

### References and Text Books:

- |                                    |                |
|------------------------------------|----------------|
| 1. Rutley's Elements of Mineralogy | -H.H.Reed      |
| 2. Manual of Optical Mineralogy    | -Shelly        |
| 3. Optical Mineralogy              | - Paul F. Kerr |
| 4. Mineral Optics                  | -Phillips W.R  |
| 5. Elements of Optical Mineralogy  | -Winchell A. N |

### 46021P - Crystallography, Mineralogy and Optical Mineralogy Lab (Practicals):

1. Study of physical properties and diagnostic features of the selected minerals
2. Study of symmetry and form of the all classes of seven crystal systems.
3. Study of optical properties of selected minerals
4. Extinction, Pleochroism, Birefringence and optical sign

## V semester

### 56021: IGNEOUS PETROLOGY

#### Unit – I

Introduction to igneous petrology – Earth zones – Formation of igneous rocks – Crystallization of unicomponent magma – Grain of igneous rocks – Formation of glass. Crystallisation of Binary magmas – Eutectics – Mixed crystals – Crystallisation of ternary magmas – the reaction relation. Forms of intrusive igneous rocks; concordant forms and discordant forms. Composite intrusions, multiple intrusions.

#### Unit – II

Structures: Vesicular and amygdaloidal, block lava, ropy lava, pillow, flow, jointing, sheet & platy structures, columnar and prismatic structures. Textures – Definition of Texture, crystallinity, granularity, shapes of textures, micro-structures, devitrification, allotriomorphic, hypidiomorphic, panidiomorphic, porphyritic, poikilitic, ophitic, trachytic, graphic and micro-graphic textures. Reaction structures corona, myrmekitic, orbicular, spherulitic.

#### Unit – III

Classification of igneous rocks- CIPW, IUGS and tabular classification, nomenclature of Igneous rocks, composition and constitution of magma. Magmatism and tectonics, interrelationship between tectonic settings and igneous rock suite. Bowen's reaction principle. Origin of primary basic magmas. Differentiation, assimilation, role of volatiles in evolution of magmatic rocks, role of trace elements in igneous petrogenesis. Geothermo metry, geobarometry.

#### Unit – IV

Study of from structure, texture, model mineralogy, petrogenesis and distribution of the following rock types: granite, granodiorite, syenite, nepheline syenite, diorite, porphyry, pegmatite, aplite, gabbro, anorthosites, peridotite, pyroxenite, dunite, dolerite, rhyolite, obsidian, trachyte, andesite, basalt, Kimberlite, lamprophyres, Carbonatite, komatite. Introduction to IG PET software.

#### Reference Books:

1. Philpotts, A., 1992. Igneous and metamorphic petrology
2. Best, M.G., 1986. Igneous and metamorphic petrology
3. Raymond, L.A., 1995. Petrology
4. Tyrrell, G.W. The principles of petrology
5. Turner & Verhaugen. Igneous and Metamorphic Petrology

## **56023: METAMORPHIC PETROLOGY**

### **Unit – I**

Definition of metamorphism, agents of metamorphism, types of metamorphism, zones of metamorphism – metamorphic minerals – stress and anti-stress minerals. Structures of metamorphic rocks – cataclastic, maculose, schistose, granulose and gneissose. Textures of metamorphic rocks – crystalloblastic, palimpsest, xenoblastic, idioblastic.

### **Unit – II**

Classification of metamorphic rocks, concept of metamorphic facies. Cataclastic metamorphism of argillaceous and arenaceous rocks. Thermal metamorphism of argillaceous, arenaceous and calcareous rocks, dynamothermal metamorphism of argillaceous, arenaceous and igneous rocks. Plutonic metamorphism.

### **Unit – III**

Mineral assemblages and pressure, temperature conditions, characteristics of different grades and facies of metamorphism. Metasomatism and additive processes. Metamorphism and granulization, Metamorphic differentiation: anatexis and origin of migmatites. Regional metamorphism and paired metamorphic belts in reference to plate tectonics.

### **Unit – IV**

Descriptive study of the following metamorphic rocks, gneiss, schist, slate, phyllite, quartzite, marble, granulite, eclogite, amphibolite, migmatite, gneiss, charnockite and khondalite.

### **Reference Books:**

1. Philpotts, A., 1992. Igneous and metamorphic petrology
2. Best, M.G., 1986. Igneous and metamorphic petrology
3. Raymond, L.A., 1995. Petrology
4. Tyrrell, G.W. The principles of petrology
5. Yardley, B.W., 1989. An introduction to metamorphic petrology
6. Turner & Verhaugen. Igneous and Metamorphic Petrology

## **56022: SEDIMENTOLOGY**

**Unit I:** Earth Surface System: Liberation and flux of sediments, Physical, Chemical and Biological processes. Sedimentary structures and textures. Classification of Sedimentary Rocks; Sedimentation and tectonics.

**Unit II:** Sedimentary environments and facies. Continental alluvial-fluvial, lacustrine, desert-aeolian and glacial sedimentary systems. Shallow coastal clastics. Marine and continental evaporites. Shallow water carbonates. Deep sea basins. Volcanoclastic: on-land and marine. Palaeocurrents and basin analysis. Concept of sedimentary facies; basic principles of palaeoenvironment and palaeoclimate analysis. Facies modeling for marine, non marine and mixed sediments.

**Unit III:**

Application of trace element, rare-earth element and stable isotope geochemistry to sedimentological problems.

**Unit IV:** Provenance and Diagenesis of terrigenous and chemical sediments. Diagenesis of mudstones, sandstones, and carbonate rocks: changes in mineralogy, fabric and chemistry. Descriptive study of Common Sedimentary Rocks – Conglomerate, Breccia, Sandstone, Shale, Limestone, Laterite

**Reference Books:**

1. Pettijohn, F.J., Potter, P.E. and Siever, R.C., 1990: sand and sandstone. Springer- Verlag
2. Boggs Sam Jr., 1995: Principles of sedimentology and Stratigraphy, Prentice Hall.
3. Sengupta, S., 1997: Introduction to Sedimentology, Oxford-IBH
4. Davis, R.A. Jr., 1992: Depositional Systems Prentice Hall.
5. Nichols, G., 1999: Sedimentology and Stratigraphy. Blackwell.
6. Sloss. Sedimentary Tectonics

**Practicals:**

- a) Study of primary, secondary and biogenic sedimentary structures in hand specimens, in photographic atlases, field photographs and wherever possible on the outcrops.
- b) Microscopic study of sedimentary structures, textures and diagenetic features in sedimentary rocks.
- c) Microscopic study of heavy minerals.
- d) Size analysis (Sieving).

# 56024: STRUCTURAL GEOLOGY

## Unit-I

Definition, aim and objectives of structural geology. Types of structures – primary and secondary; their distinctions and importance in determination of top of beds, Outcrop, attitude of beds- strike, dip and apparent dip, use of clinometer and Brunton compass.

Mechanical principles and properties of rocks and their controlling factors – theory of rock failure; concept of stress and strain. Types of strain ellipses and ellipsoids and their properties and geological significance. 2D, 3D stress, strain analysis.

## Unit-II

Classification of folds. Mechanics of folding and buckling. Superposed folding and formation of domes and basins. Micro, meso and macroscopic folding and their importance.

Fractures and joints; their nomenclature, classification, origin and significance. Foliation, cleavage and schistosity. Lineation-types and their significance in recognition of fold generation.

## Unit-III

Definition, classification and mechanics of faults. Criteria for recognition of faults. Effects of faulting on topography – anticlinal valleys, synclinal ridges, fault scarp, fault line scarp, nappe, window and klippe. Shear zone and its characteristics.

Unconformity, definition, types of unconformities- overlap, offlap, outlier and inlier. Criteria for distinguishing the unconformity from fault.

## Unit-IV

Structure on discordant forms. Forms of extrusive igneous rocks- volcanic hill, cinder cone, composite volcano, caldera, crater and volcanic neck. Concept of petrofabric methods, field techniques, laboratory and microscopic studies, Classification of tectonites, fabric, petrofabric diagram.

## Reference Books:

1. Structural Geology by M.P.Billings
2. Structural Geology and Tectonic Principles by P.C.Badgley
3. Principles of physical geology by A.Holmes and D.L.Holmes
4. An outline of structural Geology by Bruce E. Hobbs
5. Introduction to modern structural Geology by S.K. Ghosh
6. Fracturing and folding by Ramsay

## **56025: GEOCHEMISTRY**

### **Unit – I**

Introduction to geochemistry – its scope. The earth in relation to the solar system and the Universe. Cosmic abundance of elements, composition of planets and meteorites. Structure composition and distribution of elements in the earth. Geochemical classification of elements. Geochemistry of hydrosphere, biosphere and atmosphere.

### **Unit –II**

Elementary crystal chemistry and thermodynamics. Lattice energy of crystals, principles of ionic substitution in minerals. Ionization potential, electro negativity, Pauling's rule, Periodic table with special reference to rare earth elements. Geochemistry of Uranium & Lithium.

### **Unit – III**

Introduction to isotope geochemistry, stable isotopes, geochemistry of carbon, oxygen, sulfur Isotopes, Radiogenic Isotopes, Decay scheme of K-Ar, U-Pb and Rb-Sr, carbon dating and its applications in geology.

### **Unit – IV**

Geochemical prospecting; fundamental concepts, pathfinder elements. Threshold values, geochemical anomaly. Primary and secondary dispersion Halos sampling. Geochemical cycles and Geochemical methods for prospecting of metallic minerals, petroleum and natural gas. Techniques in geobotanical survey. Introduction to geochemistry software - AQUACHEM.

### **Reference Books:**

1. Mason, B and Mooro, C.B., 1991: Introduction to Geochemistry, Wiley Eastern
2. Kranskopf, K.B., 1967 : Introduction to Geochemistry McGraw Hill
3. Faure, G., 1986: Principles or Isotope Geology, John Wiley
4. Evans, R.C, 1986: Introduction to Crystal Chemistry, Cambridge Univ.Press.

## **VI semester**

### **66021: HYDRO GEOLOGY**

#### **Unit – I**

Groundwater: Origin, types, importance and occurrence, Hydrologic cycle. Hydrologic properties of rocks – Porosity, Permeability, Specific Yield, Specific Retention, Hydraulic Conductivity, Transmissivity, Storage Coefficient; Safe Yield, Aquifer types; Subsurface distribution of groundwater; Groundwater occurrence in the different geological formations.

#### **Unit – II**

Groundwater movement, Darcy's law and its applications, Determination of Permeability in laboratory and in field: Well hydraulics: Confined, Unconfined, Steady, Unsteady and radial flow, water level fluctuations, Types of wells, drilling methods.

#### **Unit – III**

Groundwater Quality: Physical, Chemical and bacteriological parameters; Quality criteria for groundwater use, graphical presentation of water quality data, Saline Water intrusion in coastal aquifers. Problem of arsenic and fluoride, case studies.

#### **Unit – IV**

Groundwater Exploration: Geophysical and geological methods of groundwater exploration, Remote Sensing techniques and Radio isotopes in hydrogeological studies. Artificial recharge of groundwater, consumptive and conjunctive use of surface and groundwater; Groundwater budgeting and basin management. Ground water provinces of India.

#### **Reference Books:**

1. Todd, D.K., (1987), Ground water hydrology, John Wiley & Sons, New York.
2. Davies, S.N. and De Wiest, R.J.M., (1966) Hydrogeology, John Wiley & Sons, New York
3. Karanth, K.R., Hydrogeology. Tata McGrawHill Publ., New Delhi.
4. Karanth, K.A. (1997) Ground water assessment, development and management, Tata McGrawHill Publ., New Delhi



## **66022: STRATIGRAPHY AND INDIAN GEOLOGY**

### **Unit I**

Principles of Stratigraphy, History and development, Stratigraphic terminology, nomenclature and classification – Lithostratigraphy, Biostratigraphy, Chronostratigraphy Magnetostratigraphy and seismic Stratigraphy. Concept of lithofacies and biofacies. Historical Evolution of Geological Time Scale.

### **Unit II**

Principles and concepts of Sequence Stratigraphy: Scope, stratigraphic terminology. Principles of palaeogeography and paleoclimate. Completeness and incompleteness of Stratigraphic records. Preservation and Net rates of accumulation in various basinal settings.

### **Unit III**

Major stratigraphical divisions and their equivalents in India. Brief account of classification, lithology, structures and fossil content with economic importance of Archaean, Cuddapah and Vindhyan Super Groups. Gondawana super group, Triassic, Jurassic, Cretaceous formations of India. Geological history and evolution of Dharwars and their equivalents Short account of Siwaliks and Deccan Traps . Origin, composition and distribution. Intra and Inter traapeans, Tertiary and Quaternary rocks of India.

### **Unit –IV**

Age problems pertaining to Indian stratigraphy. a) Saline Series b) Deccan trap. Study of the following boundary problems with reference to India a) Precambrian - Cambrian, b) Permian – Triassic, and c) Cretaceous – Tertiary

### **Reference Books:**

1. Fundamentals of historical Geology and Stratigraphy of India – Ravindra Kumar
2. Principles of Stratigraphy - Lemon,R.R
3. Principles of Sedimentology and Stratigraphy - Boggs, S.
4. Principles of Stratigraphy - Danbar, C.O. and Rodgers, J.
5. Geology of India and Burma by M.S.Krishnan
6. Geology of India by D.N.Waldiya
7. Geology of India by M. Ramakrishna & R. Vidyanadhan

## **66023: GEOTECTONICS**

### **Unit – I**

Earth's crustal structure and earth movements – endogenic diastrophic forces and movements and exogenic forces and their importance in formation of peneplanation and oceanic plains. Isostasy – concepts and global isostatic adjustment.

### **Unit – II**

Evaluation of continents and ocean basins – Tetrahedral hypothesis, Continental drift theory of F. B. Tayler and A. G. Wegner and Plate tectonic theory – seafloor spreading, mid-oceanic ridges, continental collision and divergence, island arcs. Tectonic elements of continents and ocean basins.

### **Unit – III**

Tectonic divisions of India – peninsular India, extra – peninsular India and indo – gangetic alluvial plains. Tectonics of Precambrian orogenic belts of India. Tectonics of Gondwana basin. Geodynamic evolution of Himalayas.

### **Unit – IV**

Palaeo tectonic reconstructions – tectonic analysis of facies maps; tectonics analysis of isopach maps, diastems, angular unconformity and paleomagnetism. Neotectonics – definition, evidences for neo-tectonism and their geological significance.

### **Reference Books:**

1. Principles of physical geology by A.Holmes and D.L.Holmes
2. Aspects of Tectonics, focus on South Central India by K.S.Valdiya
3. Badge, P.C., 1965: Structure and Tectonics. Harper and Row.
4. Summerfield, M.A., 2000: Geomorphology and Global Tectonics. Springer Verlag

# **66024: PALEONTOLOGY**

## **Unit – I**

Concept of species – Nomenclature – Life through Geological Time Scale – Taphonomy – Definition of fossil – Modes of preservation of fossils – Index fossil – Zone fossil.

## **Unit – II**

Morphology, classification and evolutionary trends of Graptolites, Corals, Trilobites and Brachiopods.

## **Unit – III**

Morphological and evolutionary trends of Mollusks (Lamellibranches, Gastropods and Cephalopods), Echinoderms – Palaeobotany, Plant fossils.

## **Unit – IV**

Scope of Micropaleontology – Detailed morphology of Foraminifera, Ostracoda – Utility of microfossils in hydrocarbon exploration, oxygen and carbon isotope studies of microfossils and their uses in palaeocenographic, palaeoclimatic interpretation Palaeoecology, Palaeobiogeography.

## **Reference Books:**

1. Invertebrate Paleontology – Henry woods
2. Principles of Invertebrate Paleontology – Shorrock & Twenhofel
3. Elements of Micropaleontology – Bignot. G
4. Principles of Micropaleontology – F. H. Glessener

# **66025: GEOPHYSICAL EXPLORATION**

## **Unit – I**

Introduction to Geophysical Exploration. Different types of geophysical methods. Definition of Anomaly, factors controlling anomalies. Ambiguities in geophysical data interpretation. Gravity methods – principles of gravity methods – field investigations, gravity anomaly, reduction of gravity data and its interpretation.

## **Unit – II**

Geomagnetic field of the earth: Magnetic properties of rocks and minerals, principles of magnetometers, Magnetic anomalies. Field procedures, corrections to magnetic data and its interpretation.

Resistivity methods: basic principles, various types of electrode configurations: field procedure profiling and sounding. Electrical methods in ground water investigation.

## **Unit – III**

Seismic methods: fundamental principles of wave propagation: reflection and refraction surveys, elastic properties of rock, different types of elastic waves. Radiometric methods: radio activity of rocks and minerals, and instruments used in detection and measurement of radiation in different exploration techniques.

## **Unit – IV**

Application in mineral and petroleum exploration, brief outline of various well-logging techniques; principles of electrical logging and its applications in petroleum; ground water and mineral exploration, prospecting for radio active minerals.

## **Reference Books:**

1. Mining Geology by H.E. McKinstry
2. Mineral Exploration by P.K.Ramam
3. Introduction to Geophysical prospecting by Dorbin, M.B.
4. Geophysical methods in Geology by Sharma, P.V.
5. Principles of applied geophysics by Parasnis, D.S.
6. Outlines of Geophysical prospecting by Ramachandra Rao, M.B.
7. Fundamentals of Geophysics by William Lowrie.

## VII semester

### 76021: ORE GENESIS AND MINERAL DEPOSITS

#### Unit-I

Spatial and temporal distribution of ore deposits- a global perspective. Mode of occurrence of Ore bodies. Application of ore microscope. Textures, paragenesis and zoning of ores and their significance. Processes of formation of mineral deposits- magmatic concentration, sublimation, contact metasomatism, hydrothermal process, cavity filling, replacement, evaporation, sedimentation, residual and mechanical concentration, oxidation and supergene sulphide enrichment.

#### Unit-II

Precious Metals – Mineralogy, genesis, uses, distribution of Gold, Silver and Platinum in India.  
Non-Ferrous Metals - Mineralogy, genesis, uses, distribution of Cu, Pb, Zn in India.  
Iron and Ferro Alloy Metals - Mineralogy, genesis, uses, distribution of Fe, Ni, Cr, and Mo in India. Mineralogy, genesis, uses, distribution of Atomic minerals.

#### Unit-III

Minerals used for chemical Industry- mineralogy, genesis, uses, distribution of Sulphur and Pyrite, Baryte, Fluorspar in India. Minerals used for Ceramic Industry: mineralogy, genesis, uses, distribution of Gypsum, Talc, Steatite and Soapstone and Clay in India.

#### Unit-IV

Minerals used for Fertilizer industries: mineralogy, genesis, use and distribution of Rock phosphates and phosphorites, Gypsum, Apatite.  
Minerals used for Refractory Industry: mineralogy, genesis, use and distribution of Graphite, Dolomite, Magnesite, Kyanite, Sillimanite and Andalusite, Fire clay and Ball clay in India.  
Minerals for insulation and Electrical industry: mineralogy, genesis, use and distribution of Mica, Asbestos in India.

#### Reference Books:

1. Ore Deposits – Lindgren, W.
2. Ore Deposits – Park, Jr. C.F. and MacDiarmid, R.A.
3. Ore Petrology – Stanton, R.L.
4. Economic Mineral Deposit – Bateman, A.M. and Jenson, M.L.
5. Ore Microscopy – Cameron, E.C.
6. The ore Minerals and their intergrowths – Ramdohr, P.

# 76022: MINING AND ORE BENEFICIATION

## Unit-I

Introduction to mining terminology. Preliminary and detailed mining. Tracing and outlining of mineral deposits. Mining methods- surface mining- alluvial, open pit and open cast mining. Sub-surface mining- classification of stoping methods, underground development different types of stoping.

## Unit-II

Mine supports, Subsidence, Methods of breaking of rocks, mine atmosphere, ventilation, drainage, pumping, haulage and winding. Mining hazards and safety measures. Sampling methods- Chip channel, trench, cutting and underground mine samples. Methods of drilling- diamond, core, rotary, percussion and auger drilling. Bore hole problems. Preparation of mine plans.

## Unit-III

Principles of mineral processing- methods of treatment- sequence of operations and its importance, Properties of minerals and rocks and their considerations in ore techniques. Primary crushers- jaw crushers, rod crusher, gyratory crusher. Secondary crusher- cone crusher, hammer mill and gravity sampler. Grinding mills- ball mill, rod mill, pebble mill, tube mill, hand mill, industrial screens, stationary.

## Unit-IV

Movable and vibrational classifiers- sizing classifiers, mechanical classifiers, pneumatic classifiers. Jigging- methods of design hand jigging, bacum jig, dauber jig, pneumatic jig, tabling- flowing film concentration- principles; Humphrey spiral jigging tables- shaking tables Wilfrey table.

Flocculation and description- flotation- agglomeration- physical and chemical aspects- technology-, magnetic separation.

## Reference Books:

1. Mineral Beneficiation and agglomeration plant in India- Indian bureau of Mines, Nagpur
2. Oreprocessing- S.K.Jain
3. Principles of mineral dressing- A.M.Gaudin
4. Mineral Processing- E.J.Pryor
5. Courses in Mining Geology- R.N.P.Arogyaswamy
6. Mining Geology- H.C.Mckinstry
7. Elements of ore dressing-A.F.Taggart
8. Mineral Economics-R.K.Sinha and N.L.Sharma
9. Ore deposits of India- Their distribution and processing- K.V.G.K.Gokhale and T.C.Rao

## **76023: Aerial Photography and Photogrammetry**

**Unit I** Introduction, Energy Sources and Radiation Principles, Energy Interactions, Data Acquisition and Interpretation. History and Photographic Basics, Aerial cameras – Lens and Aerial Photographs. Planning and execution of Photographic flights, Ground Coverage and Area measurement.

**Unit II** Geometry of Aerial Photographs, Scale of Photographs. Image Displacement. Stereoscopic vision and stereoscopes, Image Parallax, Rectification, Control for mapping from photographs. Aerial mosaics: Types of mosaics - Uncontrolled, semi-controlled, and Controlled. Digital Elevation Model. Application of orthophoto and Digital Elevation Model.

**Unit III** Aerial Photo/Image interpretation – Factors affecting image quality, techniques of interpretation- Photo/image recognition elements – tone, texture, colour, shape, shadow, association and pattern. Three dimensional photogrammetry: Data capturing, image coordinate system, image space coordinate system, interior orientation and exterior orientation. Production of maps and orthophotos.

**Unit IV** Geotechnical analysis – land form, drainage, vegetation and Land use analysis. Interpretation of lithology: Igneous, Sedimentary and metamorphic rocks. Interpretation of various structural elements – Bedding, foliation, joints, folds, faults and lineaments.

### **Reference Books:**

1. Photogeology by Miller V.C. and Miller C.F., 1961.
2. Aerogeology by Bandat, H.F.V., (1962)
3. Aerial photographs in Geological interpretation and mapping by Ray R.G., (1961)
4. Aerial photographs and their applications by Smith, H.T.U. (1943)
5. Principles of Remote Sensing, Longman Curran, P. 1985.
6. Elements of Photogrammetry Woll, P.R. 1974 McGraw Hill Book Co., Tokyo.
7. Photogrammetry Moffit H.F. and Edward, M.M, 1980.
8. Mapping from Aerial Photographs Burside, C.D., 1985.
9. Aerial Photography & Remote Sensing Bhatt.A.B.
10. Qiheyans, Map Projection transformation, Principles and its Applications.
11. Rampal; Handbook of Aerial Photography and interpretation, concept publishing.
12. David Paine; Aerial Photography and image interpretation for Resource. Management, John Wiley & Sons, N.Y.

# 76024: FIELD GEOLOGY AND SURVEYING

## UNIT – 1

**FIELD GEOLOGY:** Toposheet, map topo and map reading. Various methods of locating appoint on toposheet or map. Basic field procedures: Determination of slopes and gradient, measuring differences in elevation. Basic field observations at a point or out crop.

Geological mapping: general considerations, reconnaissance, study of surface features and rocks. Transfer of field data collected on to a base map, finalization of map, preparation of geological cross section.

Contouring: Definitions of contour-Contour internal-characteristics of contours. Direct and indirect methods of contouring. Uses of contours. Grade contours.

## UNIT-II

**SURVEYING & MEASUREMENTS:** Surveying – History; Definition; Classification; Principles of surveying; Plan and map; Measurements – Basic Measurements and methods; Scale – Scales used for Maps and plans

**CHAIN AND PLANE TABLE SURVEY:** Principles of chain survey, use and adjustment of various instruments employed in chain survey. Offsets and error in offsets. Obstructions in chaining. Errors and sources of errors. Determination of areas by chain survey. Plane table survey- preparation of detailed maps.

**COMPASS SURVEY:** Use and adjustment of prismatic and surveyor's compass. Methods of surveying with a compass. Magnetic Declination, Local attraction. Errors in Prismatic Survey. Drawing up field books. Plotting of compass survey..

## UNIT-III

**DUMPY LEVELLING:** Definitions and Principles of construction of a leveling instrument and its various parts with special reference to the spirit bubble and the telescope. Use and adjustment of Dumpy and tilting levels. Establishment of Bench Marks by Levelling. Methods of booking and reduction of levels. Errors in levelling.

## UNIT-IV

**THEODOLITE:** Transit Vernier Theodolites , Setting, use and temporary adjustments. Use of micro- optic thedolite. Measurements of horizontal angles and bearings by repetition and reiteration methods. Permanent adjustments of a transit theodolite.

**Total Station :** Features, concepts, types and applications

## Reference Books:

1. Surveying Vol I & II by K R Arora, Standard Book house.
2. Fundamentals of Surveying by S K Roy, Prentice- Hall of India Private Ltd.
3. Surveying Vol I, II & III by B.C.Punmia , Ashok Kumar Jain & Arun Kumar Jain -Laxmi Publications.
4. Plane Surveying by A.M.Chandra, New age international .
5. Surveying Vol I & II by S.K.Duggal Tata Mc.graw Hill Publications.
6. Elements of plane Surveying by Arthur R Benton and Philip J Tacty. Tata Mc.graw Hill Publication



## **76025 – Elective-1(A): MARINE GEOLOGY**

### **Unit- I**

Morphology of the oceans; oceanic crust- structure, petrology and source of oceanic crust; crustal changes after formation. Sea level history.

### **Unit- II**

Nearshore geological processes on the continental shelf – Marine zones, Continental margin types: Divergent margins, Convergent margins, Transform active margins; collision processes on convergent margins.

### **Unit- III**

Deep sea sediments; Classification; Terrigenous deep sea sediments; Biogenic sediments; Authgenic sediments. The geologic record of bottom currents- Method of study; erosion, transportation and deposition.

### **Unit- IV**

Palaeo-oceanography and sediment history of the ocean basins- Pacific, Atlantic and Indian Oceans, Oceanic history of Calcium Carbonate Compensation Depth (CCD), Global palaeo-oceanography evolution- critical events in ocean history.

### **Reference Books:**

1. James P. Kennett 1982, Marine Geology, Prentice Hall
2. Shepard, F.P. 1948, Sub Marine Geology, Harper and Row
3. Seibold, E and Berger, W.H. 1982 The Sea Floor, Springs- Verlag
4. William W.A. Nikovechine and R.W. Strenburg, The World Ocean
5. Pipkin, B.N., Gorsline, D.S., Cassey, R.E. Hammind, D.E., 1972 Laboratory Exercises inoceanography, Freeman

## **76025(B): OCEANOGRAPHY**

### **Unit- I**

Physical properties of sea water, salinity, temperature, density and their distribution. Specific volume anomaly, sound in the sea, color of sea water, light in sea, sea ice, absorption and extinction coefficient in the sea.

### **Unit-II**

Waves and tides: Characteristics of waves, growth and decay, transformation of waves in shallow water, wave breaking, measurement of waves, characteristics of tides, tide theories, tide gauge. Global Conveyor belt circulation. Tsunamies

### **Unit-III**

Sea as source of raw materials; Chlorinity, Eh, pH of sea water, transparency; refractive index and electrical conductivity. Geochemical balance of oceans. Major and minor elements and factors effecting their distribution.

### **Unit-IV**

Dissolved and particulate organic matter in the sea. Its nature, origin and distribution, photosynthesis and respiration. Dissolved gases- Oxygen, CO<sub>2</sub>, and their solubility in sea water. Factors effecting the concentration of sea water. Nitrogen and phosphorous cycle in the sea.

### **Reference Books:**

1. Descriptive Physical Oceanography by G.L.Pickard
2. Dynamical Oceanography by S.Pond and G.L.Pickard
3. Introduction to marine chemistry- J.P.Riley and R. Chester, Academic Press, London (1971) Chapters 1 to 9
4. Marine Chemistry- D.P.Martin, Vols. I & II 2<sup>nd</sup> Edition, Marcel, Dukker, Inc., New York (1976)
5. Practical hand book of sea water analysis by J.D.H.Stickland and T.R.Parson, Fis, Res. Board Canada, 2<sup>nd</sup> Ed., 1972

## VIII semester

### 86021: SATELLITE REMOTE SENSING

#### UNIT-I

**Introduction to Remote sensing:** History and basic concepts. Advantages of Remote sensing, aerial conventional ground surveys. History of space energy. Geostationary and Sun synchronous satellites. Sensors and its resolutions of Land sat, Spot and IRS series. Development of Remote sensing in India.

#### UNIT-II

**Physics of Remote sensing:** Electromagnetic energy, Electromagnetic radiation, interaction of Electromagnetic radiation with atmosphere and Electromagnetic radiation with the earth surface. Atmospheric windows and spectral regions useful for Remote sensing.

**Data Acquisition:** Platforms- Terrestrial, aerial and space borne. Sensors- passive sensors, photographic cameras, Vidicon television camera, multispectral scanners and microwave radiometer Radar altimeter and scatrometer. Active sensors- Radar and Lidar

#### UNIT-III

**Multispectral Remote sensing:** Multispectral photography and multispectral scanning. Remote sensing in solar optical region- basic characteristics and its interpretation.

**Remote sensing in thermal infrared region:** Basic concepts and its characteristics. Geological interpretation of thermal imagery. Advantages of thermal imagery.

#### UNIT-IV

**Microwave Remote sensing:** Basic concepts, characteristics of radar imagery. Radar geometry and resolutions and data acquisition. Advantages and disadvantages of Radar imagery.

Interpretation of lithology, structure, landforms, land use and land patterns using satellite imagery.

#### REFERENCES

1. Remote Sensing principles and interpretation, by Sanfrancisco. Sabins, F.F.jr 1978.
2. Remote Sensing and Image Interpretation Lillis and, T.M. and P.W. Kiefer, 1986.
3. Remote Sensing Geology by R.P. Gupta, 1991.
4. Principles of Remote Sensing Curran, Longman.
5. Applied Remote Sensing, Lo.C.P. 1986 Longman.
6. Introduction to Remote Sensing of the Environment, B.F.jr.(Ed), 1978. Kendall/Hunt, Dubuque, Iowa.
7. A Guide to Remote Sensing-interpreting images of Earth Drury S.A.1990. Oxford Science Publications, Oxford.

# 86022: DIGITAL IMAGE PROCESSING

## Unit I

**Introduction of Digital Image Processing:** Need for Digital Image Processing, interpretability of raw data, raster and vector files, Digital image, Image formats and its characteristics, Image magnification, Image reduction.

Statistical analysis in image processing: Bin functions, Standard deviation, Variance, covariance, correlation coefficient. Significance of image statistics in image processing.

## Unit II

**Image pre-processing:** Introduction, radiometric errors due to sensor, sun angle and haze and its corrections. Geometric errors due to earth curvature, Earth rotation and unstable satellite platform. Panoramic distortion

General concepts on map projections, geometric rectification, georeferencing and image to image registration.

## Unit III

**Image enhancement:** Need for image enhancement. Radiometric enhancement: Contrast stretching- linear, non-linear, histogram equalization and histogram stretching. **Spatial enhancement:** Filtering in spatial domain: low-pass filtering, high-pass filtering, Edge enhancement, linear edge enhancement- Laplacian filtering, non-linear edge enhancement- Sober- prewitt filtering. **Spectral enhancement:** Principle component analysis, decorrelation stretch, tasseld cap transformation, hue, saturation and intensity transformation, band ratio/indices.

## Unit- IV

**Image classification:** Need for image classification, image space and feature space. Process of classification, pattern recognition and feature extraction, supervised classification, minimum distance to mean, parallelepiped and maximum likelihood. Unsupervised classification, isodata clustering, pixel analysis and RGB clustering and data accuracy assessment. Problems in image classification, image mosaicing and change detection.

### Reference Books:

1. American Society of Photogrammetry, 1983: Manual of Remote Sensing (2<sup>nd</sup> Ed), ASP Falls Church, Virginia.
2. Duda, R.D and PE Hart 1972: Pattern Classification and Scene analysis, Wiley Interscience. New York.
3. Jensen, J.R 1986: Introductory Digital Image Processing: A Remote Sensing Perspective. Prentice. Hall, New York.
4. Leviadi, S (Ed) 1984: Digital Image Analysis, Pitman, London.
5. Pratt, S.K. 1978 : Digital Image Processing, Wiley- Interscience, New York
6. Rosenfeld, A and A.C. kek, 1982: Digital Picture Processing, Academic Press, New York.
7. Schowengerdt, R.A 1983: Techniques for Image Processing and Classification in Remote Sensing, Academic Press, New York.
8. Swain Phillip, H 1978: remote sensing the quantitative approach, McGraw hill international book co.,
9. Rosen field a 1976: topics in applied physics digital picture analysis, springier vela, Berlin, Heidelberg

## **86023: ENVIRONMENTAL GEOLOGY**

**Unit – I** Principles of environmental geology; spectrum of environment, ecological perspective of environment; Land and its use, land desertification and land degradation and land management.

**Unit – II** Soil profile, origin of soil, classification of soils, soil types of India, and soil conservation; Soil degradation due to irrigation, use of fertilizers and pesticides; Water resources – hydrological considerations, problems and management.

**Unit – III** Environmental management in mining, Impacts of mining activities on the environment, erosion, causes and control.

**Unit – IV** Geoenvironmental hazards – volcanoes, earthquakes, floods, landslides, coastal hazards. Pollution and energy – Global warming, water contamination, waste disposal, alternate sources of energy.

### **Reference Books:**

1. Valdiya, K.S. 1987, Environmental Geology – Indian Context, TATA-McGraw Hill, New Delhi
2. Keller, E.A. 1978, Environmental Geology- Bell and Howell, USA
3. Subramanian, V, 2001, Text book of Environmental Science, Narosa Publication, New Delhi.
4. Chenna Kesavulu, N. Text book of Engineering Geology, McMillan India Ltd. New Delhi

## **86024: Geospatial Technology, GNSS and Digital Cartography**

### **Unit I**

Introduction to GIS: Definition and Meaning and usefulness of GIS - Components of GIS - Computer Hardware and Software Modules. Data structures: Data structures in GIS – Raster and Vector Data Structures. Type of data (Points, Lines and Polygons) – Data Conversion, (Vector to Raster and Raster to Vector).

### **Unit II**

Data Input, Verification, Storage and Output: Data Input Processes and Devices – Different types of entering Spatial and Non – Spatial data – Data Verification (Data Quality and Errors) – Storage – Topology - Data output processes. Digital Elevation Modeling: Need for three dimensional models – Methods of DEM – Products of DSM-DTM and usefulness of DEM.

### **Unit III**

GNSS: Introduction – Concepts and segments: Satellite, Control and User segments – Signal components, Errors – Types of errors and errors in observations and accuracy. Navigation and Data collection – waypoints, routes and tracks using GPS. DGPS. Merits and demerits of DGPS. IRNSS-GAGAN.

### **Unit IV**

Digital Cartography: History of Cartography and types of Maps. Principles of Map Design and symbolization - Colors and Patterns. Generalisation in Cartography. Digital Input : Data types & data sources and Thematic Maps. Cartographic processes – Making of various maps - Special merits of digital cartography.

### **Reference Books:**

1. Borough, P.A 1986 PRINCIPLES OF GEOGRAPHICAL INFORMATION SYSTEMS FOR LAND RESOURCES Assessment, vkarabdibe press, oxford.
2. Gauche, N.C 1970: urban land use study through aerial photo interpretations techniques, pink publishing house, mature.
3. Kang Tsung Chang, Geographical Information Systems
4. Campbell, J 1984: introductory cartography, printer's hall Englewood cliffs, Ann.
5. Dent B.D 1985: principles of thematic map design, addition- Wesley, reading, mass.
6. Freeman, H and GG. Pierson 1980: map data processing, academic press, New York.
7. Monomer, M.A 1982: computer assisted cartography- principles and prospects, prentice hall, Englewood cliffs, NJ
8. Tomlinson, R.F catkins, H.S and doff marble 1976: computer handling of geographic data, UNESCO, Geneva.
9. Graeme F. & Bonham- caster, geographic information systems for geoscientists, modeling with GIS, paragon.

## **Elective -2 - 86025(A): PETROLEUM GEOLOGY**

### **Unit-I**

Occurrence of Petroleum: Surface occurrences- Seepages, Mud volcanos- disseminated deposits- vein deposits- Kerogene shale. Subsurface occurrences: Showings- pools- fields- provinces. Reservoir rock: Classification- nomenclature- fragmental chemical- miscellaneous. Classification and origin of pore space- Primary or inter-granular- Secondary of intermediate- relationship between porosity and permeability.

### **Unit-II**

Reservoir fluids- water, oil, gas. Water- Classification- Character oil field brines. Oil- chemical, physical properties. Gas composition- impurities and gas hydrates. Reservoir traps: General and structural, Classification of traps- structural traps- caused by folding- by faulting- by fracturing. Reservoir traps: Stratigraphic, primary stratigraphic traps, in clastic rocks, in chemical rocks. Secondary stratigraphic traps. Reservoir traps: Combination and salt domes.

### **Unit-III**

Origin of petroleum: Organic origin- nature of organic source, materials- modern organic matter. Transformation of organic matter into petroleum, bacterial action- heat and pressure- alteration of petroleum. Migration and accumulation of petroleum: Primary migration: water squeezed out of clays- normal water circulation- sedimentary oil- recycled oil. Secondary migration: entrained particles- capillary pressure- displacement phenomena- buoyancy- dissolved gas effects- accumulation- tilted oil- water- contacts- stratigraphic barriers- vertical migration- time of accumulation. Exploration: Surface and subsurface observations, subsurface and production- geology- well logs and maps.

### **Unit-IV**

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.

### **Books:**

1. Geology of petroleum by A.I.Levorsen.
2. Petroleum Geology by K.K.Landes
3. Principles of petroleum by W.L.Russell
4. Stuttgart Holson, G.D. and Tiratsoo, E.N. 1985: Introduction to petroleum geology. Gulf pub; Houston, Texas,
5. Tissot, B.P. and Welte, D.H. 1984: Petroleum formation and occurrence, Springer- verlag
6. Selley, R.C., 1998: Elements of Petroleum Geology

## **86025(B): FUEL GEOLOGY**

### **Unit-I**

Petroleum: Composition- nature- origin: inorganic and organic theories- migration (primary and secondary) and accumulation of oil and gas- Geographic locations- petroleum reservoir rocks- Reservoir rock types, Geological age of reservoir rocks- Reservoir traps- Classification of traps, anticlinal theory- Structural traps caused by folding, faulting and fracturing.

### **Unit-II**

Primary stratigraphic traps, Fluid traps, Salt domes, Salt plugs, Cap rocks association traps. Origin reservoir conditions. Oil bearing basins of India. Geology of the productive oil fields of India. Position of oil and natural gas in India. Future prospects and economic scenario.

### **Unit-III**

Coal: Definition- origin, sedimentology of coal bearing strata. Rank, grade and type of coal. Chemical characterization: Proximate and ultimate analysis. Coal forming epochs in the geologic past. Geological and geographical distribution of coal in India. Detailed geology for important coal fields in India.

### **Unit-IV**

Atomic minerals: Mode of occurrence and association of atomic minerals in nature. Atomic minerals in nature. Atomic minerals as source of energy. Methods of prospecting and productive geological horizons in India. Nuclear power stations of country and future prospects. Atomic fuels and environment.

### **Books:**

- a. Petroleum formations and occurrences by Tissort B.P. and Welte D.H. 1984
- b. Text book of coal by Chandra, D., et al., 2000
- c. Uranium ore deposits by Dahlkamp F.J. 1993



## **IX semester**

### **96021: ENGINEERING GEOLOGY**

#### **Unit I**

Engineering properties of rocks, soils like specific gravity, porosity, permeability, compressive strength, hardness, toughness, percentage of wear, tensile strength, modulus of elasticity, modulus of compression and residual stress and their importance in construction of civil engineering structures. Definition of quarrying of rocks, site for quarry, methods of quarrying – quarrying with hand tools, quarrying with channeling machine, quarrying by blasting, precautions in blasting.

#### **Unit II**

Neotectonism, seismic hazard and damage assessment, seismic problems of India, Earthquake resisting structures, Classification, causes of landslides, controls of landslides subsidence and its importance, site selection for ghat roads. Detection of causative factors for soil erosion, soil conservative measures. Determination of magnitude measurement and location of epicenter and focus.

#### **Unit III**

Definition and parts of dam, types of dams, geotechnical considerations in selection of dam sites, case histories – Nagarjuna Sagar Dam and Srisaïlam Dam, characters for investigating relative suitability, geological consideration for reservoir sites. Types of tunnels, objects of geological investigations, methods of investigation, geological considerations in tunnels, types of bridges, Geology for bridge sites, problems of constructing civil engineering structures in areas prone to landslides, faulting, earthquake and coastal erosion.

#### **Unit IV**

Application of Remote Sensing and GIS in river valley projects: dams and reservoirs, site suitability evaluation (lithological, structural, geomorphological considerations). Application of Remote Sensing and GIS in Seismic hazards, Landslides Ghat roads- bridges, culverts, route location (highway and rail roads) canal and pipeline alignments, tunnel constructions. Site suitability evaluation (lithological, structural, geomorphological, slope, gradient, economic considerations).

#### **Reference Books:**

1. Engineering materials by S.C. Rangwala
2. Text book of Engineering Geology by N.Chennakesavulu.
3. Principles of Engineering Geology and Geotectonics by D.P.Krynine and Judd, W.R.
4. Engineering Geology by B.S.Sathya Narayanaswamy
5. Principles of Engineering Geology by K.V.G.K.Gokhele
6. Engineering and General geology by Parbin Singh.
7. Remote Sensing and Image Interpretation, Lillesand, T.M., Keifer, R.W.,
8. Remote Sensing Principles and interpretation, Sabins F.F.,
9. Remote Sensing Geology, Singh, R.P.,
10. Image Interpretation Geology, Drury, S.A.,
11. Engineering Geology by D.Venkat Reddy

# **96022: NATURAL RESOURCE EXPLORATION.**

## **Unit I**

Stages of mineral exploration: prospecting and exploration. Methods of choosing target areas – study of background literature, ground methods, aerial and spatial methods. Criteria for accepting or rejecting the target area.

## **Unit II**

Geological exploration: guides to ore search- stratigraphic, lithological, geomorphological, structural, rock alteration and geo-botanical guides. Concepts of drilling, planning and execution of bore holes, methods of drilling: Air rotary drilling, Air percussion drilling, Mud rotary drilling and Diamond drillings

## **Unit III**

Geochemical Prospecting: Principles of Geochemical prospecting – Geochemical environment, Geochemical Dispersion- primary and secondary. Geochemical mobility and associated elements. Sampling techniques bed rock, soil, vegetation, water and stream sediment and interpretation of data. Geochemical anomalies – significant – non significant and displaced anomalies.

## **Unit IV**

Remote Sensing applications in various stages of mineral exploration. Spectral characteristics of alteration of minerals - Hydroxyl bearing minerals, carbon and tectosilicates and colour ratio images using digital image processing. Application of Remote Sensing in exploration of gold, base metals (copper, lead and zinc), diamond, bauxite, iron and baryte.

## **References:**

1. Arogyaswamy: Courses in Mining Geology
2. McKinstry: Mining Geology
3. GK Gokhale: Ore Deposits of India.
4. Dobrin M.B Introduction to geophysical prospecting
5. Levinson, A.S., Introduction to Exploration Geochemistry
6. Rose, A.W., Hakes, H.E. and Webb, U.S., Geochemistry of the Mineral Exploration.
7. Drury, S.A., Image Interpretation in Geology.
8. Gupta R.P., Remote Sensing Geology
9. Sabins, F.F., Remote Sensing Principles and Interpretation.

## **ELECTIVE -3 -96023(A): PRECAMBRIAN GEOLOGY**

### **Unit- I**

Precambrian Geology of India: Introduction, previous studies, tectonic framework of India-Cratons and mobile belts. Dharwar craton: Introduction, regional stratigraphy structure, metamorphism and tectonic evolution. Granulite belts of India.

### **Unit- II**

Introduction to Granite-Greenstone belts. Dharwar Schist belts: Sargur schist belt, Bababudan schist belt, Shimoga schist belt, Chitradurg schist belt, Gadag schist belt, Hutti schist belt, Sandeer schist belt, Hangund schist belt. Kolar Schist belt, Ramagiri- Penakacherla schist belt, Znnagiri schist belt, Veligallu schist belt.

### **Unit- III**

Bastar Craton: Regional stratigraphy, description of stratigraphic units, Mafic dykes and tectonic evolution.

Singbhum Craton: Introduction, supracrustals and granitoids, volcanic succession, north Singbhum orogeny and tectonic evolution

### **Unit- IV**

Bundelkhand Craton: Introduction, supracrustal- gneisses- Bundelkhand granite and tectonic evolution.

Aravalli Craton: Introduction, tectonic stratigraphic units and their description. Regional metamorphism and tectonic evolution.

### **Reference Books:**

1. Geology of India and Burma by M.S.Krishnan
2. Geology of India by D.N.Valdiya
3. Principles of physical geology by A.Holmes and D.L.Holmes
4. Geology of India (2008) - M.Ramakrishna and R. Vaidyanadhan

## **96023(B): DIMENSIONAL, DECORATIVE STONES AND GEMS**

### **UNIT-I:**

Ornamental and building stones of India – Commercial granites and their classification. Geological aspects in the quarrying of commercial granites – Selection criteria and evaluation – Quarrying techniques.

### **UNIT-II:**

Physical and Engineering properties of granites, dolerites, marble, sandstone and slates and Environmental impacts of granite quarrying. Commercial \_\_\_\_\_?

### **UNIT-III:**

Granite cutting and polishing – Processing- Granite marketing-History of Granite Industry in India with special reference to Andhra Pradesh, Tamil Nadu and Karnataka.

### **UNIT-IV:**

Characteristic features of Gems-Classification and identification tests of gems – Gemstone mines – Exploration in India – Distinction between natural and synthetic gemstones – Gem properties and instruments for identification.

### **Reference Books:**

1. Practical Gem cutting, Nance and Ronperry, David & Charles, London, 1982
2. Gem and Gem Industry in India, Karanth, K.V., Geol. Soc. India., Bangalore
3. Decorative and Dimensional stones by Venkat Reddy

## **ELECTIVE-4 - 96024(A): WATERSHED MANAGEMENT**

### **Unit- I**

Watershed : Definition, scope, characteristics and classification. Topography, Channel Networks, Geomorphology and Soils, Vegetation and Landuse LandCover. Aquifers and derivation of aquifer parameters. Evaluation of aquifer characteristics.

### **Unit- II**

Hydrologic Processes : Hydrological Cycle, Precipitation, Interception, Evaporation and Transpiration, Infiltration and Runoff. Ground Water recharge and its estimation.

### **Unit-III**

Soil and Water conservation: Soil and soil erosion controlling measures on waste lands and agricultural lands and forests. Rain water harvesting, soil moisture conservation, Rain Water Harvesting Structures. Artificial Recharge Programmes - Bhungroo.

### **Unit- IV**

Integrated approach for sustainable development. Geospatial techniques for ground water studies and land form analysis. Participatory Rural Appraisal (PRA): Basic principles, assumptions, important types and benefits. Case studies - Ralegaon Siddhi.

### **Reference Books:**

1. Ground water flow and mass transport modeling for Assesment and Management of Aquifers by K.Palanisami, M.Thangarajan, and A.K.Sinha
2. Hydrology and watershed management, JNTU, by B.Venkateswara Rao, G.Jaganmohan Das, C.Sarala and M.V.S.S.Girdhar
3. Engineering Hydrology by K.Subramanyam, Tata McGraw Hill, New Delhi.

# 96024(B): DISASTER MANAGEMENT

## Unit- I

Fundamental concepts of Disaster management: Hazard, Disaster, Risk, Vulnerability, Management. Natural and anthropogenic hazards.

Elements of hazard mapping, risk analysis, damage assessment, loss analysis, hazard mitigation.

## Unit- II

Environmental Hazards: Soil and land degradation, Mining hazards, deforestation, forest fire.

Flood mapping and monitoring. Drought prediction and monitoring. Cyclone prediction and hazard assessment. Tsunami and sea mounts

## Unit- III

Volcanic hazards, volcanic belt girdling in India, sub continent origin and types of volcanic activity, nature of volcanic hazards, prediction of volcanic eruptions, Mitigation of volcanic hazards.

## Unit- IV

Disaster management policy, National disaster framework. Disaster mitigation. Planning and strategies for implementation. Role of remote sensing and GIS in disaster mitigation measures.

## Reference Books:

1. Environmental geology- Indian context K.S. Valdiya (1987).
2. Environmental geology- Flawn, P.T. (1970).
3. Environmental Geology- Keller, E.A. (1976).
4. Landslide and their control- Zaruba, Q and Menel, V (1969).
5. Focus on Environmental geology- Tank, R. W. (1973).
6. Environmental geology- C.W. Montgomery (1989).
7. Environmental geology- D.R. Coats (1981).
8. All you wanted to know about disasters- (Brig) B.K. Kanna (2005).

## **96024(C): QUATERNARY GEOLOGY**

**UNIT-I** Quaternary stratigraphy: Introduction, scope and its classification-biostratigraphy, microforaminiferal stratigraphy, nannoplanktonic stratigraphy, diatom stratigraphy, radiolarian stratigraphy, faunal abundance stratigraphies, climatostratigraphy and oxygen isotope stratigraphy, magnetostratigraphy.

**UNIT-II** Quaternary palaeoclimate: climate proxies. Causes of ice ages and other climate changes, cyclic variation in the amount of carbon dioxide and other greenhouse gases in the atmosphere. Variation in amount of volcanic dust and sulphate aerosols in the atmosphere. Variations in solar output, global palaeoclimate, climatic changes in India, Indian Ocean and Arabian ocean, western Rajasthan, Northern India, greenhouse warming model, impact of human induced CO<sub>2</sub> on biota

**UNIT-III** Quaternary sea-level changes, ocean mass / level distribution, quaternary sea-levels, Milankovitch theory of climatic changes, sea-level indicators, sea-levels indicators along Indian coast, Global sea-level changes, Effect of tectonism on sea-level records at plate boundaries, Sea-level changes along Indian coastal margins. Quaternary dating methods, radiometric dating methods, non-radiometric dating methods,

**UNIT-IV** Structure and neotectonics of east coast India with special reference to Andhra Pradesh. Structure and neotectonics of west coast India with special reference to Kutch. Tectonic geomorphology, neotectonics, active tectonics and their applications to natural hazard assessment.

### **Reference Books:**

1. Quaternary Geology Indian Perspective, U.B. Mathur, Memoir 63, Geological Society of India, Bangalore
2. Geology of Andhra Pradesh, P.K. Ramam and V.N. Murthy, Geological Society of India, Bangalore

## **ELECTIVE – 5-96025(A): GEOINFORMATIC APPLICATIONS IN SOIL, FORESTRY, ENVIRONMENT AND AGRICULTURE**

### **Unit I**

Soil survey methods- soil classification Land evaluation- saline alkaline problems in soil identification and mapping, soil erosion, soil conservation.

Forest taxonomy, Invention of forest land- vegetation Assessment, Factors responsible for forest degradation and deforestation, Delineation of degraded forest damage assessment, emerging concepts in classification of forest and action plan- comparing forest genetic resource from theory and practical.

### **Unit II**

Pollution control to air and water. Pollution studies and its significance on an environment: physico-chemical and geological parameters of near shore and fore shore ecosystems- marine pollution- oil spills, processes of oil- water interface- effects on ecosystems, sewage treatment and disposal, Solid waste Management

### **Unit III**

Classification of crops, cropping seasons, integrated systems, High yielding varieties, hybrids, seeds, seed production. Introduction to agriculture, Importance of agriculture in Indian economy, General features of Indian Agriculture, Food production status, factors affecting plant growth.

### **Unit IV**

Spectral characteristics of soil, crops and vegetation, Change detection study: crops and forest, forest damage assessment and forest fire, solid waste, Sewage treatment and disposal using Remote Sensing data

### **Reference Books:**

1. Steven M.D and Clark, J.A. Application of Remote Sensing in Agriculture, Butterworths, London, 1990
2. Champion, H.G and Seth, S.K. Revised forest types of India. Government of India press, New Delhi, 1968.
3. Ghassem Asrar. Theory and Application of optical remote sensing. John Wiley & sons, New York, 1989.
4. Space Applications centre- Manual of procedure for forest Mapping and Damage Detection using Remote sensing Data, Report No. IRS-UP/SAC/FMDD/TN/16/90, 1990: pp-58.
5. Space Applications centre-Status Report on crop Acreage and Production Estimation, Report No. RSAM/SAC/CAPE/SR/25/90, October 1990, pp-253.



## **96025(B): MINERAL ECONOMICS**

### **Unit-I**

Mineral economics as a concept. Importance of minerals in National Economy. Use of metals, non-metals and fuels. Peculiarities inherent in Mineral Industry. International aspects. Legislation related to minerals. Minerals in India, National mineral policy.

### **Unit-II**

Classification of minerals- Major, Minor, Fuels and Industrial minerals, Strategic, Critical and essential minerals. Present and future minerals supply of the world.

### **Unit-III**

Resources, production and import and export of minerals in the world and India's status. Tenor, grade and specification of important minerals with examples.

### **Unit-IV**

Demand and supply of fuels and minerals. Conservation and substitution of minerals- low-grade ore, use of scrap, new technologies, synthetics and synthesis. Changing pattern of mineral consumption. Mineral Industry in Andhra Pradesh and its growth.

### **Reference Books:**

1. Mineral Economics by R.K.Sinha and Sharma.
2. Minerals in world industry by Voskinil, W.H
3. An introduction to mineral economics by K.K.Chaterjee
4. Indian Bureau of Mines mineral year books

## **RESEARCH METHODOLOGY**

### **Unit-I**

Basic principles of Research, concept, objectives, types, approaches and significance of research. Scientific methods, research process and constraints for research in India. Identification of ore minerals - Megascopic, microscopic, polished techniques; minerals under reflected light, microscopic principles of ore dressing, processing methods - Jigging, tabling application of these methods.

### **Unit-II**

Computation and analysis of geochemical data. Construction and interpretation of variation diagram. Calculation of mineral formulae, normative calculation of rock data, instruments for various analysis: methods, techniques and interpretation of chemical analysis by following instruments: Atomic Absorption Spectrometer (AAS), X-ray diffraction; Calorimeter, flame photometer and XRF. Eh and Ph diagrams.

### **Unit-III**

Introduction to computer applications in geology, table formatting and graphs generations. Database Management System (DBMS), data models, data abstraction, geo statistics, tabulation, liner and multiple regression, constructions, preparation and interpretation of litho facies map.

### **Unit-IV**

Remote sensing application for preparation of topographic and thematic maps. Identification of land forms - fluvial, volcanic, glacial and coastal landforms. Methods and tools of acquisition, processing analysis and interpretation of remotely sensed data. Morphometric analysis of drainage data, delineation of drainage basin, sub basin and sampling techniques of surface, sub surface water samples for monitoring of water quality. Collection of soil samples and soil profiles.