# CHOICE BASED CREDIT SYSTEM IN P.G.COURSES

## Master of Science in Geophysics

## (M. Sc. Geophysics)

**Scheme of Instructions and Examination**
**Revised for 96 Credits**

**Effective from the Academic Year 2016-17**


**CENTRE OF EXPLORATION GEOPHYSICS**
**DEPARTMENT OF GEOPHYSICS**
**OSMANIA UNIVERSITY**
**HYDERABAD 500 007**


**2016-17**

**OSMANIA UNIVERSITY**
**CHOICE BASED CREDIT SYSTEM IN P.G.COURSES**
CENTRE OF EXPLORATION GEOPHYSICS,
DEPARTMENT OF GEOPHYSICS, HYDERABAD -500007.

## M. Sc. GEOPHYSICS, I YEAR I SEMESTER

Scheme of Instructions and Examination (Effective from the Academic Year 2016-17)

**Theory: I-Semester.**

| S. No. | Subject Code | Subject Theory | Instruction Hrs./Week | Exam. Duration | Max. Marks | | Total Marks | Credits |
|---|---|---|---|---|---|---|---|---|
| | | | | | Internal Asses. | Semester Exam | | |
| 1 | GP 101 T | Applied Mathematics | 4 | 3 | 20 | 80 | 100 | 4 |
| 2 | GP 102 T | Basic Geology | 4 | 3 | 20 | 80 | 100 | 4 |
| 3 | GP 103 T | Electronics & Instrumentation | 4 | 3 | 20 | 80 | 100 | 4 |
| 4 | GP 104 T | Physics of the Earth | 4 | 3 | 20 | 80 | 100 | 4 |
| **Total:** | | | **16** | | **80** | **320** | **400** | **16** |

**Practicals:**

| S. No. | Subject Code | Subject | Instruction Hrs./Week | Exam. Duration | Total Marks | Credits |
|---|---|---|---|---|---|---|
| 5 | GP 151 P | Applied Mathematics and Computer Programming | 3 | 2 | 50 | 1 |
| 6 | GP 152 P | Basic Geology& Surveying | 3 | 2 | 50 | 1 |
| 7 | GP 153 P | Electronics & Instrumentation | 3 | 2 | 50 | 1 |
| 8 | GP 154 P | Physics of the Earth | 3 | 2 | 50 | 1 |
| 9 | GP 155 F | Surveying and Geological Field work | 4 | | 100 | 4 |
| **Total:** | | | **16** | | **300** | **8** |

**Note:**

1. Practical Examination will be conducted at the end of each Semester. Every Practical Examination will be of 50 marks.
2. Fieldwork: At the end of the I year 1st Semester the students will submit a Field Report on the Fieldwork in Surveying and Geological Fieldwork (GP 155 F) conducted in 1stSemester. The Field reports are assessed by conducting a viva-voce consisting of a Committee (External Examiner, HOD, Chairman BOS and concerned teacher), the marks are awarded for their performance.
3. The **student will have to pay a sum of Rs. 1,500/-per annum** to the University at the time of admission along with University Fee for field training.

**Course: GP 101 T M. Sc. GEOPHYSICS I YEAR I-SEMESTER**

**Subject: APPLIED MATHEMATICS**

## Unit – I

**Vectors:**

Double & Triple integrals, application,
Line integral
Green's theorem in a plane, surface integral
Divergence theorem
Stokes Theorem
Laplacian differential Operators in Cylindrical & Spherical System,
Geophysical examples.

**Tensors:**

Introduction
Definition
Contraction, Direct product
Quotient rule
Pseudo tensors
Dual Tensors
Studies of some Geophysical examples.

**Analytic Functions:**

Functions of a complex variable. Mappings Limits. Theorems on Limits Continuity Derivatives. Differentiation Formulas. The Cauchy Riemann Equations Sufficient conditions. The Cauchy – Riemann Equations in polar Form. Analytic Functions Harmonic Functions. Some Geophysical examples.

## Unit – II

**Residues:**

The residue theorem. The principal part of a function Poles quotients of Analytical functions. Evaluation of improper real integrals, improper integrals Involving Trigonometric functions integration around Branch point.

**Special Functions:**

The Gamma function
The Beta function
Relation between Beta & Gamma function
The Bessel function
Recurrence formulae for Jn(x)
Expansion of Jo(x) & J1(x)
Values of J1/2(x) & J1/2(x)
Generation function for Jn(X) Some Geophysical examples.

## UNIT -III

**Laplace Transform:**

Introduction Definition
Transforms of elementary function.
Properties of Laplace transforms
Inverse transform
Transforms of derivation
Transform of integrals
Multiplication by t
Division by t
Convolution theorem
Application to differential equation
Simultaneous linear differential equation
Periodic function. Some Geophysical examples.

**Hankel Transform:**

Introduction
Elementary properties of Hankel transform
The Hankel inversion theorem.
Hankel transforms of derivatives of function
Hankel transform of some Elementary function.
Elementary function, Some important results of Bessel function.

Hankel Transform of $\frac{d^2f}{dx^2} + \frac{1}{x}\frac{df}{dx} - \frac{n^2f}{x^2}$

## UNIT – IV

**Fourier Series & Fourier Integral Transform:**
Fourier series
Introduction Euler's Formulae
Condition for Fourier expansion
Change of interval.
Odd and Even function
Half-Range series
Boundary value problem using Fourier
Fourier integral transform series.
Fourier's Integral theorem
Fourier Transform
Fourier Cosine transform
Fourier Sine transform
Fourier transforms of derivatives.
Calculation of Fourier transforms of some simple functions.
Some Geophysical examples.

**List of Recommended Books:**


1. Murray R-SPIGEL, May 1981, Advanced Calculus, McGraw Hill, International Book Company, Singapore.
2. R.V. Churchill, 1963 Fourier series and boundary value problem, McGraw Hill Koga Kusha Ltd., Tokyo.
3. Murray R-SPIGEL, 1965, Laplace transforms, Schaums out line series Mc. Graw Hill, International Book Company, New York.
4. L.A. Pipes, 1970, Applied Mathematics for Engineers & Physicists, Mc. Graw Hill, Koga Kusha Ltd., Tokyo.
5. B.S. Grewal, 1999, Higher Engineering Mathematics, Khanna Publishers Delhi.
6. Ervin Kreyszig, 1979, Advanced Engineering Mathematics, John Wiley & Sons.
7. Harry Lan, 1950, Vector and Tensor Analysis, Mc. Graw Hill, Book Company Inc., Tokyo.
8. Vasista, 1995, Integral Transform, Krishna prakasham Mandir, Meerut-UP.
9. Lann.Sneddon, 1979, the use of Integral transforms Tata Mc. Graw Hill Book Co.
10. George Arfkin, 1970, Mathematical Methods for Physicists Academic Press.
11. R.V. Churchill, J.W. Brown, R.F. Verhey, 1974, Complex variables and Applications - Mc. Graw Hill Book Company.
12. Charles, B. Officer, 1974, Introduction to theoretical Geophysics, Springer – Verlag Publ. Comp.

**Course No: GP 102 T M. Sc. GEOPHYSICS I YEAR I SEMESTER**

**Subject: BASIC GEOLOGY**

## Unit-I

## (PHYSICAL GEOLOGY)

**Introduction:** Definition of Geology -Basic principles of Geology – its relationship with other sciences Different branches of Geology – Aim and applications of Geology. Origin of the earth -brief review of different theories.

**Weathering of rocks:** Agents and Types of weathering.

**Rivers:** Source and surface flow of water-erosion, transportation and development of landforms by deposition – V- shaped valleys, river capture phenomena. rapid, water fall, alluvial fan, meander, ox Bow Lake, flood plain.

**Mountain:** Types, causes of mountain building, horst, graben.

**Volcanoes:** Parts of typical volcano, products of volcano, types of volcanic eruptions,

## Unit – II

## (CRYSTALLOGRAPHY AND MINERALOGY)

**Crystallography:**

Definition of a crystal – Amorphous and crystalline states. Morphology of crystals: Face, edge, solid angle, interfacial angle.

**Form:** Simple, combination, closed, open pinacoid, prism – pyramid and dome. Symmetry **Elements:** Plane of symmetry, axis of symmetry, centre of symmetry, Crystallographic axes, parameters, indices, crystallographic notation, parameter systems of Miller, law of rational indices, classifications of crystals into 7 systems.

**Mineralogy:**

Definition of mineral – Classification of mineral into rock forming and ore forming minerals.

**Physical Properties of Minerals:** Colour, streak, transparency, lustre, luminescence, Fluorescence, Form, hardness, cleavage, fracture, specific gravity, magnetic properties.

**Optical properties of minerals:** Elementary concepts of optics, simple harmonic motion, amplitude, period, wave length, phase, polarized light, isotropic and anisotropic. Substances, reflection, refraction, Nicol prism and its construction, concepts of crossed Nichols, petrological microscope, its mechanical and optical parts, behaviour of isotropic and anisotropic minerals under crossed Nichols, pleochroism, absorption, interference Colours and extinction.

**Mode of mineral formation:** Occurrence and association of minerals, chemical properties of minerals – isomorphism – solid solution – polymorphism, mineral formation and silicate structure.

**Descriptive Mineralogy:** Study of physical, chemical and optical properties and mode of Occurrence of following minerals:

Olivine, Augite, Hypersthene, Hornblende. Actinolite, Orthoclase, Microcline, Albite, Quartz, Biotite, Muscovite, Garnet (Almandine), chlorite, Calcite, Talc, Tourmaline, Beryl corundum, Kyanite and Magnetite.

## Unit-III

## (IGENEOUS PETROLOGY)

**Introduction:** Definition of rock, chemical composition of the curst, classification of Rocks-igneous sedimentary and metamorphic rocks.

**Igneous Petrology:** Classification into plutonic, hypabyssal and volcanic rocks. Forms of igneous rocks. Lava flows, sill, lacolith, lopolith, dyke, cone, sheet ring dyke, volcanic neck, Phacolith, Botholith, structures: vesicular, amygdaloidal, block and ropy lava, pillow:

**Textures:** Definition of texture, microstructure, allotromorphic, hypidiomorphic, Panidiomorphic, ophitic, intergranular, porphyritic, poikilitic, intersectral and intergranular, Classification of igneous Rocks

**Origin of Igneous Rocks:** Bowen's reaction principle, differentiation and assimilation.

**Descriptive study of following igneous rocks:** Granite, granodiorite, syenite, porphyritic granite, Pegmatite gabbro, dunite, peridotite, dolerite, rhyolite, obsidian and basalt.

## Unit-IV

## (SEDIMENTARY AND METAMORPHIC PETROLOGY)

**Sedimentary Petrology:**

Introduction, mode of formation source, Transportation and deposition, classification of Sedimentary rocks, Structures and textures of sedimentary rocks,

**Brief description of the following sedimentary rocks:**

Conglomerate, breccia, sandstone, greywacke, shale, limestone, dolomite, Shelly and limestone.

**Metamorphic Petrology:**

Introduction: Definition, Types and agents of metamorphism; structure and textures of metamorphic rocks – grades and zones of metamorphism.

**Brief description of the following metamorphic rocks:** Quartzite, marble, slate, phyllite, schist, gneiss, charnockite and Khondalite.

**List of Recommended Books:**


1. Arthur Holmes, 1978, Principles of physical Geology.
2. Rutleys, 1991, Elementary of Mineralogy – Revised by Gribble, C.D. CBS, Publishers and Distributors.
3. Tyrrell, G.W. 1975, The Principles of Petrology B.I. Publications.
4. Hueng, W.T., Petrology 1962, McGraw Hill Co.,
5. Wingley, B.F. 1995, The Evolving Continent New York. John Wiley and Pars.
6. Canilic, K.C., 1977, Plate tectonics and Crustal evolution – (*) Butterworth Heinemann.

**Course No: GP 103T M. Sc. GEOPHYSICS I YEAR I SEMESTER**

**Subject: ELECTRONICS and INSTRUMENTATION**

## Unit – I

**Devices:**

Characteristics of JFET, UJT, SC R &.CMOS Transistors.

**Amplifiers:**

Single stage RC coupled amplifier and its frequency response. The concept of feedback. Positive and Negative feedback. Advantages of Negative feedback. Emitter follower and Darlington Pair.

## Unit – II

Introduction to digital gates (AND, OR, NOT & NAND) Combination logic - basic building blocks, Qualitative treatment of Multiplexers, Demultiplexes, Encoders and decoders.

**Sequential logic:** Basic RS flip-flop, D, T, JK flip-flop, Qualitative treatment of counters and shift registers.

**Memory:** Read only Memory (ROM) &, Random Access Memory (RAM).

## Unit-III

**Operational amplifiers:**

Characteristics of ideal operational amplifiers. Feedback equation.

**Applications:** Inverting (amplifiers); Non-inverting amplifiers, Integrator, Differential for summing amplifier, Differential amplifier, DC Voltage follower, Pulse width discriminator.

**Basic concepts of instrumentation:**

A descriptive treatment of instrument as a part of system. Linear systems, Static and Dynamic characteristics error and uncertainty in measurements.

## Unit – IV

**Equipment:**

Cathode ray Oscilloscope (Qualitative treatment) and CRO Probes. Count rate meters, amplitude discriminator and Timers. Basic Principles of series regulated power supply, (Block diagram approach using voltage regulated IC's) Principles of inverter and converter

Circuits.

**Data indicators and recording:**

Analogue versus digital measurement, voltmeters Potentiometer recorder, Numerical displays, LED and LCD, Concept of magnetic tape recording.

**List of Recommended Books:**


1. Millman and Halkias Electronic devices and Circuits, International student Edition, McGraw-Hill International Book Company, 1972.
2. D. Patranabis, Principles of industrial instrumentation.
3. W.D. Cooper, Electronic instrumentation and Measurement techniques, Prentice Hall of India Pvt. Ltd., New Delhi 1979.
4. Anthony S. Maneva, Solid state electronic circuits for Engineering Technology (McGraw – Hill, Kogakusha, Ltd., International student edition 1983.
5. Jacob Millman & Christors C, Halkias 1983 Integrated electronics, analogy and digital circuits and systems. International student edition McGraw – Hill, Kogakusha Ltd
6. Malvino and Leach, Digital principles and Applications.

**Course No: GP 104T M. Sc. GEOPHYSICS I YEAR I SEMESTER**

**Subject: PHYSICS OF THE EARTH**

## Unit – I

**Introduction to Geophysics:** Geophysics and its importance among earth Sciences.

**Solar system:** Earth as a member of the solar system, basic facts relating to The earth's position in the solar system.

**Geospheres:** Scope of study of various Geospheres, Atmosphere, Ionosphere, Asthenosphere, lithosphere-hydrosphere and Biosphere.

Meteorology, Oceanography and Hydrology.

**Atmosphere:** Constituent, vertical structure, weather analysis and fore casting.

## Unit.-II.

**Gravity field:** Gravity field and its variations on the surface, internal and external Field, Geoid, spheroid and Ellipsoid of the earth. Shape and size of the earth.

Geomagnetic field, Magnetic elements and description of the magnetic field, Origin and Reversals of the magnetic field.

**Paleomagnetism:** Natural Remnant Magnetisation, Measurement of direction and intensity of NRM. Continental drift and polar wonder curves.

**Geothermics:** Heat sources, Geothermal flux distribution over continents and oceans.

**Geochronology:** Rock dating methods, U-Th, K-Ar, Rb-Sr, C-14, Fission-Track and magnetic dating.

## Unit-III

**Petrophysics:** Different physical and Engineering properties of rocks Laboratory measurements of the physical properties of rocks namely Density, Seismic wave velocities, magnetic susceptibility, Electrical resistivity, thermal conductivity, porosity and permeability.

## Unit-IV

**Seismology:** Natural and Artificial seismology and its relation to other Earth System sciences. Classification of Earth quakes, Causes and propagation of Different seismic wave and fundamental laws.

**Introduction to Seismograph:** Principle and brief description of mechanical type seismograph. Milneshaw, wood Andersen seismograph, electromagnetic seismograph and broadband seismograph.

Various methods for determination of focal depth and epicentral location. Interior of the Earth and Earth quake prediction. Concepts of Geodynamics.

**List of Recommended Books:**


1. P.V. Sarma, 1976, Geophysical Methods in Geology, Elsevier.
2. Howell, 1959, Introduction to Geophysics, McGraw Hill Book Co. New York.
3. R.E. Sheriff, 1989, Geophysical Methods. Prentice Hall Engle Wood Cliffs. New Jersey.
4. I.K. Kaul, S. Senugupta and A.K. Bhattacharya, 1990, General and Applied Geophysics (An introduction), Associate of, Geophysics.
5. F.D. Stacey, 1977, Physics of the Earth, John Wiley and Sons, New York.
6. Rezhevisky and Novik, 1971, Physical properties of Rocks, Mir Publications.
7. Richter, C.F. 1969, Elementary Seismology, Eurasia Publishing house, Pvt. Ltd. New Delhi.

## Course No: GP 151 P  M. Sc. GEOPHYSICS I YEAR I SEMESTER

**Practicals:**

### Subject: APPLIED MATHEMATICS and COMPUTER PROGRAMMING

1. Solution of steady state distribution of temperature in a slab – Laplace's Equation in an infinite strip INS (P 93 – 95).

2. Error function – Application of Laplace transform INS (p. 155-161)

3. Edge detection problem using Fourier Cosine and Fourier sine transform (INS p. 43-46)

4. Some problems on Gamma, Beta function.

5. Some problems on Tensors.

6. Problem on motion of a viscous fluid under a surface load – Using Hankel transforms (INS P. 333-338)

7. Determination of fluid flow at the core surface from geomagnetic observation understanding of mathematical aspect. (NJV/GN P.189-208.)

## Course No: GP 152P M. Sc. GEOPHYSICS I YEAR I SEMESTER

**Practicals:**

### Subject: BASIC GEOLOGY

**Crystallography: Study of the following crystal models.**

1. Cube
2. Octahedron
3. Dodecahedron
4. Tetragonal prism with pinacoid
5. Tetragonal pyramid
6. Hexagonal prism with pinacoid
7. Hexagonal pyramid
8. Orthorhombic prism with pinacoids
9. Monoclinic pinacoids
10. Triclinic pinacoids

**Mineralogy: Study of the following rock forming minerals:**

| S. No. | A. Megascopy | S. No. | B. Microscopy |
|---|---|---|---|
| 1 | Olivine | 1 | Quartz |
| 2 | Augite | 2 | Orthoclase |
| 3 | Hypersthene | 3 | Microcline |
| 4 | Enstatite | 4 | Plagioclase |
| 5 | Hornblende | 5 | Biotite |
| 6 | Quartz | 6 | Muscovite |
| 7 | Muscovite | 7 | Hornblende |
| 8 | Biotite | 8 | Augite |
| 9 | Garnet | 9 | Olivine |
| 10 | Orthoclase | 10 | Garnet |
| 11 | Microcline | | |
| 12 | Plagioclase | | |
| 13 | Tourmaline | | |
| 14 | Epidote | | |
| 15 | Corundum | | |
| 16 | Apatite | | |
| 17 | Calcite | | |
| 18 | Beryl | | |
| 19 | Gypsum | | |
| 20 | Talc | | |

**Petrology: Study of the following Rock Types**

| S. No. | Megascopy of Rocks | S. No. | Thin Sections of Rocks |
|---|---|---|---|
| 1. | Granite (Pink & Grey) | 1. | Granite |
| 2. | Syenite | 2. | Gabbro |
| 3. | Pegmatite | 3. | Dolerite |
| 4. | Gabbro | 4. | Basalt |
| 5. | Basalt | 5. | Sand stone |
| 6. | Sand stone | 6. | Marble |
| 7. | Gneiss | | |
| 8. | Schist | | |
| 9. | Marble | | |
| 10. | Charnockite | | |
| 11. | Khondalite | | |

## Course No: G 153 P M. Sc. GEOPHYSICS I YEAR I SEMESTER

**Practicals:**

### Subject: ELECTRONICS and INSTRUMENTATION

1. Handling and operation of power supply, Multimeter and oscilloscope.
2. RC Coupled amplifier.
3. Emitter follower.
4. IC 555 as timer.
5. Experiments with IC 741 Operational amplifier.
6. RS, D,T ,& JK flip-flop

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## Course No: GP 154 P M. Sc. GEOPHYSICS I YEAR I SEMESTER

**Practicals:**

### Subject: PHYSICS OF THE EARTH

1. Computations on the shape and size of the earth.
2. Analysis of radiometric data. Determination of ages of rocks.
3. Statistical Analysis of physical properties of Rocks.
4. Laboratory measurements of physical properties of rocks.
    a) Density
    b) Seismic wave velocity
    c) Magnetic susceptibility
    d) Electrical resistivity
    e) Porosity
5. Interpretation of Earthquake records.

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**Course No: GP 155F M. Sc. GEOPHYSICS I YEAR I SEMESTER**

**Practicals:**

**Subject: SURVEYING GEOLOGICAL FIELD PRACTICE**

1. **Introduction:** Definition; principles; types and various applications of surveying; Field and office work; Scale of a map or plan. Study of Toposheet

2. **Linear Measurements:** Distance measurements, sources of errors and corrections in linear measurements. Chain surveying, Fieldwork and plotting, obstructions in chain surveying, measurement of offsets.

3. **Direction measurement:** Bearing and its types, determination of magnetic bearing, prismatic compass, declination, compass survey.

4. **Levelling:** Determination of levels, Levelling-definition, principle, method and classification. Instruments levels and levelling staff, their construction, use and adjustment, sources of errors and precautions. Contours and contouring methods and uses.

5. **Surveying with GPS:** Determination of positions: Total station-principles; GPS-principles and its uses.

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## M. Sc. GEOPHYSICS I Year II SEMESTER

Scheme of Instructions and Examination (Effective from the Academic Year 2016-17)

**Theory: II- Semester.**

| S. No. | Subject Code | Subject Theory | Instruction Hrs./Week | Exam. Duration | Max. Marks | | Total Marks | Credits |
|---|---|---|---|---|---|---|---|---|
| | | | | | Internal Assessment | Semester Exam | | |
| 1 | GP 201 T | Applied Geology | 4 | 3 | 20 | 80 | 100 | 4 |
| 2 | GP 202 T | Theory of Fields | 4 | 3 | 20 | 80 | 100 | 4 |
| 3 | GP 203 T | Electrical Methods | 4 | 3 | 20 | 80 | 100 | 4 |
| 4 | GP 204 T | Seismic Methods | 4 | 3 | 20 | 80 | 100 | 4 |
| **Total:** | | | **16** | | **80** | **320** | **400** | **16** |

**Practicals**

| S. No. | Subject Code | Subject | Instruction Hrs./Week | Exam. Duration | Total Marks | Credit |
|---|---|---|---|---|---|---|
| 5 | GP 251 P | Applied Geology | 3 | 2 | 50 | 1 |
| 6 | GP 252 P | Theory of Fields | 3 | 2 | 50 | 1 |
| 7 | GP 253 P | Electrical Methods | 3 | 2 | 50 | 1 |
| 8 | GP 254 P | Seismic Methods | 3 | 2 | 50 | 1 |
| 9 | GP 255 F | Fieldwork (Geological and Geophysical-1) | 4 | - | 100 | 4 |
| **Total:** | | | **16** | | **300** | **8** |

**Note:**

1. Practical Examination will be conducted at the end of each Semester. Every Practical Examination will be of 50 marks.
2. Fieldwork: At the end of the I year 2nd Semester the students will submit a Field Report on the Fieldwork in Geological and Geophysical Fieldwork-1 – (GP255 F) conducted in the 2nd Semester.
3. The field reports are assessed by conducting a viva-voce consisting of a Committee as (External Examiner, HOD, Chairperson BOS and concerned teacher), and the marks are awarded for their performance.
4. It is mandatory for the students to undertake geological field training programme organized at a suitable location for a week's duration during/end of the II Semester.

**Course No: GP 201 T M. Sc. GEOPHYSICS I YEAR II SEMESTER**

**Subject: APPLIED GEOLOGY**

## Unit – I

## (STRUCTURAL GEOLOGY)

**Definition of Structural Geology:** objectives of structural geology-primary and secondary structures; bed, bedding planes, outcrop, attitude of beds, strike, dip and apparent dip.

**Folds:** parts of a folds, nomenclature of folds: Anticline, syncline, symmetrical fold, asymmetrical fold, overturned fold, recumbent fold, isoclinal fold.

**Recognition of Folds in the Field:** Direct observation, inferred folds, plotting attitude of beds on a map, aerial map pattern, drilling, mining and Geophysical methods, Determination of top of beds by primary features. Ripple marks, cross bedding, graded bedding, sole markings, local unconformities and related features.

**Joints:** Definition, geometric and genetic classification.

**Faults:** Terminology of fault plane; nature of movement along faults: Translational and rotational movements, relative movements, Effects of disturbed strata. Throw and heave; Classification: Geometrical classification, Genetic classification. Classification based on absolute movements.

**Recognition of Faults in the Field:** Discontinuity of structures, repetition and omission of strata's, features characteristics of fault plane, silicification and mineralization, physiographic criteria.

**Unconformities:** Types of unconformities, local unconformity, angular unconformity, nonconformity and disconformity.

Introduction to the theory of plate Tectonics.

## UNIT-II

## (STRATIGRAPHY AND INDIAN GEOLOGY)

**Introduction and Principles of Stratigraphy:** Standard Geological time scale, Principles of correlation Physiographical sub-divisions of India.

A brief study of area, distribution Lithology and economic importance of the following geological groups of India.

Dharward
Cuddapah
Kurnool
Gondwana
Deccan Traps.

## Unit-III

## (ECONOMIC GEOLOGY)

**Introduction:** Ore minerals, gangue, ore and ore deposits. Synergetic and epigenetic mineral deposits.

**Ore genesis:** A brief outline of the following types of deposits and their characteristics features.

**Magmatic deposits:** Formation of Chromite, magnetite and diamond deposits.

**Hydrothermal deposits:** Formation and migration of hydrothermal solutions. Causes of precipitation of ore minerals. Cavity filling and replacement deposits. Classification of hydrothermal deposits. Hydrothermal alteration. Formation of Copper, Lead Lime, Gold and barite deposits.

**Sedimentary deposits:** Source, solution transportation and deposition.

**Residual Concentration:** Formation of bauxite deposits.

## Unit-IV

## (PETROLEUM GEOLOGY)

**Petroleum Geology:** Chemical composition and physical properties of petroleum crude, origin of petroleum, migration of oil and gas, gas hydrates .Reservoir rocks-classification, hydrocarbon traps, Petroliferous basins of India.

**List of Recommended Books:**


1. Billings, M.P.1974, Structural Geology, Printice Hall.
2. Krishnan, M.S. 1982 Geology of India and Burma CBS Publishers.
3. Carotic, K.C. 1977, Plate Tectonics and Crustal Evaluations, Butterworth – Heinemann.
4. Best, Myron G., 1986 Igneous and Metamorphic Petrology CBS Publishers and Distributors.
5. Jenson, M.L. and Bateman, A.M. 1981, Economic Mineral Deposits – John Wiley &Sons
6. Kreiter, V.M. 1965, Geological Prospecting and Exploration, Mir publications.
7. Krishnaswamy S., 1972, India's Mineral Resources – Oxford & IBII Publishing Co.,
8. Dutt, N.V.B.S., 1986, Geology and Mineral Resources of Andhra Pradesh., N.R.D.C.S., Ltd.

**Course No: GP 202 T M. Sc. GEOPHYSICS I YEAR II SEMESTERS.**

**Subject: THEORY OF FIELDS**

## Unit-I

Mathematical and physical field, continuity, scalar and vectors , Static fields in free space, Coulomb's law, Field intensity, line of force, charge density, curl of vector, Stokes theorem, Gauss's law, Gauss's divergence theorem, Poisson's and Laplace's equation. Electrical dipole, Double layer.

## Unit -II

Conductors and Dielectrics: Nature of conductors and dielectrics, polar and non-polar dielectrics. Harmonic functions. Orthogonal curvilinear, spherical and cylindrical coordinates, Method of images, Green's theorem, Green's function, Green's equivalent stratum, Dirichlet and Neumann problems. Electric fields in conductors, Ohm's law in differential and integral forms, conductive current and displacements current, equation of continuity. Relation between resistance and capacitance

## Unit-III

Magnetic flux, Magnetic vector potential, induction in magnetic media, Relation between gravity and magnetic potentials .The H-field, magnetic susceptibility and permeability, boundary conditions. ferromagnetism, magnetic poles ,magnetic scalar potential.

## Unit-IV

Electromagnetic induction, law of inductions, Electric and magnetic energy densities, displacement currents, electromagnetic energy and pointing theorem. Maxwell's equations and electromagnetic waves, The wave equation, the waves in conducting media, Vector and scalar potentials of an electromagnetic field. Electromagnetic radiation from an oscillating dipole

## List of Recommended Books:


**1.** Introduction to theory of fields by V. L. S. Bhimasankaram, G.A, Soloviev and S.V. SeshagiriRao 1973.

**2.** Theory of Elasticity by Soloviev.G.A. Geophysical Field theory and method. Gravitational, electric and magnetic fields. Academic press. Alexander A. Kaufman, 1992.

## Course No: GP 203 T M. Sc. GEOPHYSICS I YEAR II SEMESTER

## Subject: ELECTRICAL METHODS

### Unit-I

Basic Principles of electrical methods of prospecting. Classification of methods. Electrical properties of rocks and minerals Influence of (1) mineral composition (2) moisture and salinity (3) Temperature on resistivity.

DC methods of laboratory determination of resistivity. Two electrode, four electrode and bridge methods.

Basics of theory of DC Propagation in resistivity methods. Flow of current through the earth media- Description of the potential and electrical field due to simple source of current (monopole, dipole and linear sources). Current distribution. Solution of Laplace equation in layered media.

### Unit-II

**Basics of Resistivity methods of prospecting:** Concepts of True and Apparent resistivities. Two electrode, Three electrode Dipole, Schlumberger, Wenner arrays and their Geometric factors, Principle of reciprocity.

**Electrical Profiling (EP):** Basics of electrical resistivity profiling. Response of EP with, Two electrode, Three electrode, Dipole- Dipole, Schlumberger &Wenner arrays over a vertical contact. The Unipole, combined and Schlumberger arrays and their use in different cases of prospecting, double and multi separation profiling. Field procedure and illustration of results and interpretation.

### Unit-III

**Vertical Electrical Sounding (VES):** Apparent Resistivity over a layered earth. Master curves for Schlumberger arrays- Types of two, three and multiplayer VES curves. Principles of Equivalence and Principle of suppression. Construction and interpretation of VES curves by graphical (Curve matching) and Computer technique (Resistivity transforms, principles of linear digital filtering). Field procedures and examples of applications.

**Buried electrode method:** Principle of operation of charge body (buried electrode) method & its uses Resistivity imaging: Some fundamental concepts. Methods in resistivity imaging, field survey & uses.

### Unit-IV

**Electrochemical Methods:** Origin and nature of electro-chemical processes (spontaneous polarization) in the earth. exploration of sulphide ore bodies. Typical responses over sphere and rod like bodies. Field procedure for S.P. surveys and interpretation techniques

**Geological applications:**

**Induced Polarization (IP) Method:** Introduction, sources of IP, membrane and electrode polarizations, Time domain and Frequency domain measurement of IP, chargeability, percent frequency effect and metal factors, apparent chargeability over layered earth. Field Procedure, Simple Interpretation Techniques and Applications of IP Methods.

**List of Recommended Books:**


1. E.I. Parkhomenko – 1967 Electrical Properties of Rocks – Plenum Press, New York.
2. Keller and Frischkeicht, 1966, Electrical methods in Geophysical Prospecting Pergaon.
3. Telford W.N., Geldart, L.P.Sheriff, R.F. and Keys, D.A., 1985 Applied Geophysics, Cambridge Univ. Press.
4. Stanislav Mares et al..1984, Introduction to Applied Geophysics, D. Reidel Publishing.
5. D.S.Parasnis, 1977, Introduction to Applied Geophysics, Published by Chapman &Hall, London.
6. Patra and Bhattacharya 1969, Direct Current Geoelectrical Sounding, Elsevier.
7. Koefeed C, 1980, Principles of Geoelectrical Soundings, Elsevier.
8. Ward S.H., 1969 Mining Geophysics, SEG.
9. Electrical Imaging surveys for environmental and engineering studies. By M.H.Loke

**Course No: GP 204 T M. Sc. GEOPHYSICS I YEAR II SEMESTER**

**Subject: SEISMIC METHODS**

## Unit – I

Historical Development and Background of Refraction and Reflection Methods, Difference between Refraction and Reflection Surveys, Propagation of Seismic Waves in Linear and Nonlinear medium, N Layered case, continuous increase of velocity. Waveforms and their characteristics, Elastic wave velocities in rocks,

## Unit – II

Basics of Seismic data Acquisition systems, Explosive and Non Explosive sources Seismic operation on Land and sea, Grouping of Geophones and shot points, Recording formats.[SEG B,SEG C,SEG D &SEG Y], Different Types of Display of Digital and Magnetic Recordings, Wiggle Trace, Variable Area and Variable Density Records Telemetric Seismic systems, Common Depth Point technique, 2D, 3D and 4D Seismic, Vertical Seismic Profiling, Deep Seismic Sounding

## Unit – III

Sequence of Digital Seismic data Processing, Seismic data reduction, Static and dynamic corrections Analysis of Multiples and Ghost Reflections, Processing of Seismic Data, Imaging, Time and Depth Sections, Seismic Inversion, Migration Techniques, Wave Equation Migration, Time and Depth Migration, Determination of Average Seismic Velocities, Synthetic Seismograms. Tomography

Processing and interpretation of Refraction Seismic data – Methods based on first and later arrivals, Hidden layer.

## Unit – IV

Application of Seismic methods in Hydrocarbon, Mining, Groundwater and Engineering studies. Mapping of Geological Structures (Faults, Reef, Pinchouts, Anticlines), Depositional Sequence and Pit Falls of Seismic Interpretations, Seismic Stratigraphy and Sequence Analysis, Seismic Facies Analysis, Reflection Character Analysis, Bright Spots, Seismic Lithologic Modelling, Vp/Vs and Lithology, AVO Analysis.

**List of Recommended Books:**


1. Dobrin M.B. Savit C.H. 1988 Introduction to Geophysical Prospecting. Mc. Graw Hill Book Company, Singapore.

2. Telford, W.M., Geldart, L.P. Sheriff, R.E. and Keys, D.A. 1981, Applied Geophysics, Cambridge University Press, Cambridge.

3. Sheriff, R.E. and Geldart, L.P. 1987 Exploration Seismology, Vol. I, Cambridge Univ. Press, Cambridge.

4. Sheriff R.E. and Geldart L.P. 1987 Exploration Seismology, Vol. II, Cambridge Univ.Press, Cambridge.

5. AnsteyN.A., 1971, Seismic Prospecting Instruments Vol, II.Gebrudev Borntraege Stuttgart.

5. Evenden B.S. and Stone, D.R., 1971, Seismic Prospecting Instruments, Gebrudev Borntraege, Berlin, Stuttgart.

6. Sheriff R.E. 1989, Geophysical Methods, prentice Hall, Englewood cliffs, New Jersey.

7. Att. Balch and M.W. Lee, 1984, Vertical Seismic Profiling. Technique, Applications and case histories, D. Reidal Publishing Company, Boston, USA.

8. Robinson, E.A., 1988, Migration of Seismic data SEG Publication.

9. Verma, R.K. 1986, Offshore Seismic Exploration Gulf Publishing Co.,

10. Gurvitch, II, Seismic Prospecting, Mir Publications

11. Yilmaz, O, 1987, Seismic Data Processing, SEG Publication

**Course No: GP 251 P M. Sc. GEOPHYSICS I YEAR II SEMESTER**

**Practicals:**

**Subject: APPLIED GEOLOGY**

**Structural Geology:**

1. Calculation of true thickness of strata.
2. Calculation of true and apparent dips.
3. Three point problem.
4. Completion of outcrops in the geological maps
5. Drawing cross sections of the geological maps with inclined strata, folds, faults, unconformities and their interpretation.

**Economic Geology:**

Megascopic study of the following ore minerals with special reference to their Diagnostic physical properties, composition, mode of formation, distribution and industrial applications.

1. Magnetite
2. Hematite
3. Galena
4. Chalcopyrite
5. Sphalerite
6. Muscovite
7. Barite
8. Chrysotile (asbestos)
9. Bauxite
10. Talc
11. Gypsum
12. Kyanite
13. Pyrolusite
14. Psilomeland
15. Graphite.

## Course No: GP 252P M. Sc. GEOPHYSICS I YEAR II SEMESTER

**Practicals:**

### Subject: THEORY OF FIELDS

1. Computations of electrical potential and field due to spherical and cylindrical charge distributions along a radial line.
2. Construction of equipotential lines due to a dipole-charge on a plane surface.
3. Computation of Electric field distribution in space in the vicinity of a dielectric-conductor boundary due to the presence of a charge in the dielectric.
4. General and particular solutions of Laplace equations as applicable to different coordinate systems.
5. Computation of the current density variations in the vicinity of the boundary of two conducting media, due to the presence of a point electrode.
6. Computation of magnetic field. Variations along the axis of a (i) finite, (ii) semi-infinite solenoid.
7. Computation of electric field distribution due to a magnetic dipole of given moment.
8. Simple problems on propagation of plane waves in conducting media.

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## Course No: GP 253 P M. Sc. GEOPHYSICS II YEAR III SEMESTER

**Practicals:**

### Subject: ELECTRICAL METHODS

1. Calculation of normal field due to a point source and dipole source
2. Calculation of normal field between two points source
3. Computation of Resistivity profiling curve with a Three Electrode Spread over a vertical contact
4. Computation of Resistivity profiling curve with a Four Electrode Spread over a vertical contact
5. Graphical construction of VES curves
6. Analytical construction of VES curves
7. Application of Curve matching techniques in interpretation of VES curves
8. Computer interpretation of VES data
9. Computation and interpretation of S.P anomaly over a sphere
10. Computation and interpretation of S.P anomaly over a slab

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**Course No: GP 254 P M. Sc. GEOPHYSICS II YEAR III SEMESTER**

**Practicals:**

**Subject: SEISMIC METHODS**

(A) Computation :

1. Construction of travel time curves of direct and refracted waves (Horizontal layer)
2. Construction of travel time curves of direct and refracted waves (Dipping layer)
3. Construction of travel time curves of reflected waves. (Horizontal layer).
4. Construction of travel time curves of reflected waves (Dipping layer).
5. Processing and interpretation of given refraction seismograms.
6. Processing and interpretation of given reflection seismograms.
7. Velocity analysis.
8. Signal and noise statistics from seismic traces.

(B) Practical's:

1. Study of elements of seismic channel.
2. Study of the Seismic refraction reflection unit.
3. Acquisition of shallow depth seismic refraction data.
4. Processing and interpretation of acquired shallow depth Seismic refraction data.

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**Course: GP 255 F M. Sc. GEOPHYSICS I YEAR II SEMESTER**

**Fieldwork-I**

**Subject: GEOLOGICAL and GEOPHYSICAL FIELD WORK**

1. Measurement of Dip, Strike using clinometers and Brinton compass

2. Study of out crops. Identification of Rocks & their Structures i.e. Faults, Folds, Joints, and fracture detection etc.

3. Preparation of Geological Map, showing Structures, Lithology & Other Geological features.

**Note:** Fieldwork will be conducted in a suitable location.
Field Report in Surveying Field Practice & Geological Field Practice will be submitted at the end of 2nd Semester.

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## GEOPHYSICAL FIELD PRACTICE

### 1. Electrical Methods

a) Profiling
b) Vertical Electrical Sounding using Symmetrical
c) Schulmberger 4- Electrode Configuration & Radial VES
d) SP Potential Profiling over a Geological target & Radial SP

### 2. Seismic Methods

Testing of Geophones & Recording Equipment including Identity. Refraction Seismic Field Surveys.

**Note:** Fieldwork will be conducted in O.U Campus only. The Fieldwork consists of acquisition, Processing & Interpretation of data by the respective methods. Field Report on Geophysical Field Practice -1 will be submitted at the end of 2nd Semester.

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CENTRE OF EXPLORATION GEOPHYSICS,
DEPARTMENT OF GEOPHYSICS, HYDERABAD -500007.

## M. Sc. GEOPHYSICS II YEAR III SEMESTER

Scheme of Instruction and Examination (Effect from the academic year 2016-17)

**Theory: III Semester**

| S. No. | Subject Code | Subject Theory | Instruction Hrs./Week | Exam. Duration | Max. Marks | | Total Marks | Credits |
|---|---|---|---|---|---|---|---|---|
| | | | | | Internal Asses. | Semester Exam | | |
| 1 | GP 301 T | Gravity Methods | 4 | 3 | 20 | 80 | 100 | 4 |
| 2 | GP 302 T | Magnetic Methods | 4 | 3 | 20 | 80 | 100 | 4 |
| 3 | GP 303 T | Electro Magnetic Methods | 4 | 3 | 20 | 80 | 100 | 4 |
| 4 | GP 304 T | Signal Processing & Geophysical Inversion | 4 | 3 | 20 | 80 | 100 | 4 |
| **Total:** | | | **16** | | **80** | **320** | **400** | **16** |

**Practicals:**

| S. No. | Subject Code | Subject | Instruction Hrs./Week | Exam. Duration | Marks Total | Credits |
|---|---|---|---|---|---|---|
| 5 | GP 351 P | Gravity Methods | 3 | 2 | 50 | 1 |
| 6 | GP 352 P | Magnetic Methods | 3 | 2 | 50 | 1 |
| 7 | GP 353 P | Electro Magnetic Methods | 3 | 2 | 50 | 1 |
| 8 | GP 354 P | Signal Processing and Geophysical Inversion | 3 | 2 | 50 | 1 |
| 9 | GP 355 S | Seminar | 2 | - | 25 | 1 |
| 10 | GP 356 F | Geophysical Field work – 2 | 4 | - | 75 | 3 |
| **Total:** | | | **18** | | **300** | **8** |

**Note:**

1. Practical Examination will be conducted at the end of 3rd Semester. Every Practical Examination will be of 50 marks
2. **Seminar:** The student shall compulsorily deliver one seminar lecture (at end of III semester) from the core subject, which will be evaluated internally within the department.
3. **Fieldwork:** At the end of 3rd semester II year , the students will submit a Field Report on the Fieldwork Geophysical field practice – 2 (GP 355 F) conducted in 3rd semester. The Field Reports are assessed by conducting a viva- voce consisting of a committee (External Examiner, HOD, Chairman BOS and the concerned teacher) and the Marks are awarded for their performance.

**Course No: GP 301T M. Sc. GEOPHYSICS II YEAR III SEMESTER**

**Subject: GRAVITY METHODS**

## Unit-I

Principles of gravity prospecting, the gravitational field of the earth and its variation in space and time. Concept of gravity potential, Poisson's& Laplace's. Equations International Gravity Formula Factors contributing to the variation of gravity on the surface of the earth.

Concept of anomaly& Definition of micro gravity anomaly.

Density of rocks and minerals and their variations – Laboratory methods of determining density of rocks.

## Unit-II

Basic principles of Asiatic Gravimeters (Lacoste - Romberg, Worden gravimeters). Gravity survey procedures on land, at sea and in satellite gravity .Scales of survey. Establishment of gravity base stations, Reduction of land gravity data. Determination of surface rock densities using Nettleton and other empirical methods. Various corrections (Free air, Bouguer, Terrain etc), Reduction of marine and airborne gravity data, Accuracy of Anomalies, Concept of absolute & relative Bouguer anomalies, preparation of Bouguer anomaly maps.

## UNIT-III

Qualitative Analysis of gravity data – Key Variables in Gravity, Regional – Residual separation, Various techniques i.e., graphical & averaging methods-Least squares methods, Green's Equivalent layer, Gravity anomalies over common geological features. Continuation techniques, calculation of second vertical gradients.

## UNIT-IV

Quantitative analysis of gravity data, application of characteristics curves, logarithmic charts. Gravity anomaly expressions over simple geometric models. Concepts of 2D, $2^1/_2$ D and 3D models. Computation of anomalies over irregular bodies. Spectral methods in quantitative interpretation – limitation. Ambiguity in gravity interpretations.

Application of gravity methods in

(i) Regional geological and structural problems.

(ii) Mineral Exploration and Hydro carbons Exploration, application of micro gravity techniques( Structural traps, Stratigraphic Pinchouts, locating secondary faults).

(iii) Groundwater and Engineering problems

**List of Recommended Books:**


1. Stanislav Mares et al., 1984, Introduction to Applied Geophysics D. Reidel Publishing Company, Dordrecht/Boston. 581p.

2. Telford, W.M., Geldart, L.P. Sheriff, R.E and Keys, D.A., 1981 Applied Geophysics, Cambridge University Press Cambridge, U.K. 860P

3. B.S.R.Rao and IVR Murthy, 1978, Gravity and Magnetic Methods of Prospecting Arnold – Henniman Publishing Company, Delhi. 390P

4. S.H.Ward (Ed.), 1967, Mining Geophysics, Vol .1 and Vol.II SEG Publication, Tulso, Oklahma, USA.

5. Grant F.S. and West G.F., 1964, Interpretation Theory in Applied Geophysics McGraw Hill Publication, New York.

6. D.S Parasnis, 1973, Mining Geophysics, Amsterdam. Elsevier Publishers, The Netherlands; 354 P.

7. L.L.Nettleton, 1967, Gravity and Magnetics in oil Prospecting McGraw Hill Publication, New York.464 P.

8. V.L.S.Bhimasankaram &V.K.Gaur, 1978, Lecturers and Exploration Geophysics AEG, publications.CEO. O.U., Hyderabad.

9. I.V.Radhakrishna Murthy 1998, Gravity and Magnetic Anomalies Geophysics. Geological Society of India, Bangalore 363 P.

10. I.V.Radhakrishna Murthy & D.C Mishra 1989, Gravity and Magnetic Anomalies in space and Frequency domain, AEG, Publications.

11. Edwin S.Robinson and Cahit Coruh, 1988.Basic Exploration Geophysics John Wiley & Sons, New York Toronto/ Brisbane/ Singapore.562 P.

**Course No: GP 302 T M. Sc. GEOPHYSICS II YEAR III SEMESTER**

**Subject: MAGNETIC METHODS**

## Unit- I

Principles of Magnetic prospecting Magnetic field of the earth &its Variation in space and time. Concept of Magnetic potential and field Poisson's relation. Magnetic elements. Factors contributing to the main Magnetic fields of the earth. Magnetic properties of rocks and minerals –Para–dia & Ferro magnetism, Natural Remnant magnetization. Archaeo-magnetism

## Unit-II

Brief introduction to the working principles of modern Magnetometers. (Fluxgate, Proton Precession & Rubidium vapour) Magnetic survey procedures on land, marine and air borne. Satellite magnetic data. IGRF. Scales of Surveys, Accuracy, Corrections to magnetic data.

## Unit -III

Qualitative analysis of magnetic data. Regional-Residual separation by different methods

Derivatives and Continuation techniques, calculation of second derivatives, Reduction to pole

## Unit-IV

Quantitative analysis of magnetic data. Concepts of forward modelling and indirect interpretation. Magnetic anomaly expressions over simple magnetic bodies. Structure calculation and Spectral analysis for depth estimation, Ambiguity in magnetic interpretations.

Application of magnetic method in

i) Regional, Geological and Structural problems

ii) Mineral& Hydro carbon Exploration and

iii) Groundwater and Engineering problems.

**List of Recommended Books:**


1. S Mares et al., 1984, Introduction to Applied Geophysics D. Reidel Publishing Company, Dordrecht Boston. 581p.

2. Telford, W.M. Geldart. L.P. Sheriff, R.E. and Keeves. D.A. 1981 Applied Geophysics, Cambridge University Press Cambridge, U.K. 860 P.

3. B.S.R. Rao and IVR Murthy, 1978, Gravity and Magnetic Methods of Prospecting Arnold – Henniman Publishing Company, Delhi.390 P.

4. S.H. Ward (Ed.), 1967, Mining Geophysics, Vol. I and Vol. II SEG Publication. Tulso, Oklahoma, USA.

5. Grant F.S. and West G.F. 1964, Interpretation Theory in Applied Geophysics Mc Gra Hill Publication, New York.

6. D.S. Parasnis 1973, Mining Geophysics, Amsterdam, Elsevier Publishers, The Netherlands, 354 P.

7. L.L. Nettleton, 1976, Gravity and Magnetics in Oil Prospecting McGraw Hill Publication, New York.464 P.

8. V.L.S. Bhimasankaram& V.K. Gaur, 1978, Lectures and Exploration Geophysics AEG, Publications, CEG, O.U. Hyderabad.

9. I.V.Radhakrishna Murthy 1998, Gravity and Magnetic Interpretation in Exploration Geophysics. Geological Society of India, Bangalore.363 P.

10. I.V.Radhakrishna Murthy & D.C. Mishra – 1989, Gravity and Magnetic Anomalies in space and Frequency domain. AEG. Publications.

11. Edwin S. Robinson and Cahit Coruh, 1988 Basic Exploration Geophysics John Wiley & Sons, New York Toronto/Brisbane/Singapore, 562 P.

**Course no. GP 303 T M. Sc. GEOPHYSICS II YEAR III SEMESTER**

**Subject: ELECTROMAGNETIC METHODS**

## Unit-I

**Principles of Electromagnetic Prospecting:** Primary field, Secondary field, Total field, Anomaly field, amplitude, phase, real and imaginary components,

Description of elliptic polarization, relation between the major and minor axis of ellipse of polarization with real and imaginary components of secondary field.

EM wave propagation in conductive medium-skin depth. Classification of Electromagnetic methods:

Methods using artificial sources (consisting of two groups) (1) Harmonically varying field, (2) transient fields, of which the first can be sub-divided into (a) Low frequency (b) Radio frequency method and Natural field methods (Magneto telluric group of methods and AFMAC). Sub-classification based on application (ore prospecting, oil and gas investigations) and source employed. Different variants (surface, sub-surface and airborne).

## Unit-II

**Methods using Man-made fields:**

**A. Surface low frequency methods:** Effect of the change in the Frequency on the primary field, conductivity and magnetic permeability on the secondary field, discussion using the response of a conducting permeable sphere in uniform E.M. field. Effect of over burden and ore bearing rocks on the response of local conductor (only discussion)

a) Description of dipole induction profiling (horizontal loop or Slingram Method). Principles of the equipment, field procedure, quantitative Interpretation of anomalies for plate shape bodies.

b) Tilt Angle Technique – Schematic representation of results over conductive bodies (as given in Mining Geophysics by Parasnis.)

c) Turam Method – principles of equipment, field procedures, some qualitative interpretation techniques (as given in the book Electrical Methods in Geophysical Prospecting by Keller and Frischnet').

## Unit-III

**B. Surface Transient Methods:** Comparison with harmonic methods, description of different configurations, principles of equipment, general field procedures, simple, interpretation techniques.

**C. Surface High Frequency Methods**: General principles, equipment, field procedure and interpretation of a) Radiowave mapping, b) Radiowave absorption c) Ground-penetrating radar

**D. Airborne EM Methods**: Principles, advantages and disadvantages, General description of INPUT, VLF & Resolved component measuring system.

**E. General Principles of Borehole EM Methods:** Advantages and Capabilities

**F. Principles of EM Sounding by using** (a) Harmonic field (b) Transient field, Principles of equipment, field procedure, description (without mathematical treatment) of theoretical curves and interpretation.

## Unit-IV

**Methods using Natural Fields:**

a) AFMAG Method-Surface and Airborne versions (as given in the book Electrical Methods in Geophysical Prospecting' by Keller & Frinchnell

b) Magnetotelluric method: Sources of MT signal, impedance tensor. Theory of electromagnetic wave propagation in horizontally layered earth and response over multi layered earth. Principles of Equipment & Field procedure. Data processing and analysis auto and cross spectra. Processing & interpretation of MT data over a two /multi layered earth, strike, rotation, polar diagram, tipper, skew, ellipticity, TE and TM modes .Application of MT methods.

**Remote Reference & Magneto-Telluric Profiling and their applications:**

c) Telluric Current Method – Basic equations governing telluric field, field procedure, principles of equipment, processing of records by method of ellipses and interpretation of telluric parameters and maps. Applications of EM prospecting in geological mapping, mineral and Groundwater exploration.

**List of Recommended Books:**


1. Parasnis, D.S., 1973, Mining Geophysics – Elsevier.
2. Keller, G.V. Electrical Methods in Geophysical Prospecting – Frischnett, Pergamon.
3. Patra, H.P. & Mallick, K., Principles of Geoelectric Soundings Vol. II – Elsevier.
4. Telford, W.K., Geldart, L.P., Sheriff, R.F. and Keys, D.A. Applied Geophysics – Cambridge Univ. Press.

**Course No.: GP 304 T M. Sc. GEOPHYSICS II YEAR III SEMESTER**

**Subject: SIGNAL PROCESSING and GEOPHYSICAL INVERSION**

## Unit – I

### Basics of Data Processing and Integral Transforms:

Stationary time series, concepts of signal and noise, continuous and discrete Data. Deterministic and statistical processes auto and cross correlations. Fourier and Hartley transforms. Discrete transforms and FFT and FHT algorithms Z- transform. Properties, relation between Z and Fourier transforms, Hilbert transform, analytic signal, Amplitude, phase, instantaneous frequency and envelope of time series.

Radon, Walsh and Mellin transforms, their discrete transforms and properties.

### Linear System:

Linearity, casualty and stability of a system, Impulse response, transfer function, (input and output relation) Convolution theorem in time and frequency domains.

### Sampling Theory:

Time and frequency sampling theorem, comb, function, Nyquist frequency, Aliasing and Gibb's phenomenon.

## Unit – II

**Spectrum:**

Spectrum in terms of correlation functions. Spectral calculation of , observed data. Concept of maximum entropy.

**Windowing:**

Concepts of Windows Criteria for optimum window. Triangular, Rectangular, Hanning, Hamming windows.

**Filtering:**

Principles of digital filtering in time and frequency domains. Amplitude and Phase characteristic of digital filters, Low pass, high pass, and band pass. Velocity filters, and Weiner filter. Deconvolution and predictive Deconvolution techniques.

**Application:**

Applications in gravity magnetic, seismic, electrical and electromagnetic methods

## Unit – III

General discrete inverse problem – modal space data space, joint space. States of information – mathematical concept of probability, interpretation of a probability, perfect knowledge, total ignorance Shannon's measure of information content, Combination of states of information. Solving forward problem – Results of the measurements; prior information on model parameters: joint prior information in the DXM spaces.

## Unit – IV

Defining solution of inverse problem – Combination of experimental, a prior and theoretical information, and resolution of inverse problems. Solution of inverse problems – describing the a posteriori information in the model space, analysis of error and resolution, analytic solutions Montocarlo methods. Special cases – Gaussian hypothesis d= g (m); case f (d, m) = 0, generalized Gaussian, lognormal probability density. Solution of inverse problems using the Bayesian paradigm.

**List of Recommended Books:**


1. Marcus Bath, 1974, Spectral Analysis in Geophysics, Elsevier.
2. A Populis, 1962, The Fourier integral and its applications, MC Graw Hill Publishers.
3. J.F. Clarbout, 1976, Fundamentals of geophysical data processing.Mc. Graw Hill Publishers.
4. E.R. Kanasewich, 1975, Time sequence analysis in geophysics, The University of Alberta Press.
5. E.A. Robinson and S. Treitel, 1983, Digital Seismic inverse methods, D. Reidel Publishing Co.
6. R.N. Bracewell, 1986, Fourier transform and its applications, McGraw Hill Publishers.
7. J.B. Thomas, 1969, An introduction to statistical communication Theory, John – Wiley Publishers,
8. A.V. Oppenheium and R. W. Schafer. Digital signal processing, Prentice hall of India.
9. Silvia, M.T. and Robinson, E.A. Deconvolution of geophysical time series in the exploration for Oil and Natural gas. Elsevier Scientific Publishing Co.
10. Tarantola A 1984, Inverse Problem Theory, Elsevier, Amsterdam.
11. Hjelt, S.E., 1992 pragmatic Inversion of Geophysical Data, Springer – Verlag.
12. M. Bernbii, P. Carrion, G. Jacoviti, F. Rocca, S.Treitel, 1987. Deconvolution and inversion. Blackwell Scientific Publication Oxford.
13. N.J. Vlar, E. Nolet, M.J.R. Wortel, S.A.P.L. Cloetingh, 1988, Mathematical Geophysics D. Reidal Pub. Co., Tokyo.

## Course No: GP 351 P M. Sc. GEOPHYSICS IIYEAR III SEMESTER

**Practicals:**

### Subject: GRAVITY METHODS

1. Computations regarding determining average density of surface rocks from Gravity data.
2. Reduction of field gravity data.
3. Preparing gravity anomaly contour map from field data.
4. Regional-Residual separation by (a) Graphical method & (b) Grid methods.
5. Construction of gravity profiles on some simple geometrical models.(Sphere, Horizontal Cylinder & Fault )
6. Computations pertaining to basement depth estimation from Gravity.
7. Interpretation of gravity anomaly profile across a dyke.
8. Upward & Downward continuation of Gravity fields

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## Course No: GP 352 P M. Sc. GEOPHYSICS II YEAR III SEMESTER

**Practicals:**

### Subject: MAGNETIC METHODS

1. Reduction & Corrections of field magnetic data.
2. Preparing magnetic anomaly contour map from field data..
3. Regional-Residual separation by different methods in magnetic.
4. Construction of magnetic profile on some simple geometric models. (Sphere, Cylinder & Faults )
5. Computations pertaining to basement depth estimation from magnetic data by Peters half slope method.
6. Interpretation of magnetic anomaly profile across a dyke.
7. Upward & Downward Continuation of Magnetic fields.

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## Course No: GP353 P M. Sc. GEOPHYSICS II YEAR III SEMESTER

**Practicals:**

### Subject: ELECTROMAGNETIC METHODS

1. Normal field due to an underground loop source.
2. Frequency characteristics of the secondary field due to a conductive Sphere.
3. Response due to a spherical conductor in UL method.
4. Computation of Geometric factor due to a Spherical conductor in drill hole version of Transient EM method.
5. Computation of Geometric factor due to cylindrical conductor in drill hole version Transient EM method.
6. Processing of VLF EM data using Fraser Filter.
7. Interpretation of Transient EM data – Calculation of generalized induction parameter.
8. Computation of normalized response due to a conducting sphere in transient pulse induction method.
9. Computation of normalized response due to a conducting cylinder in transient pulse induction method.

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## Course No.GP 354 P M. Sc. GEOPHYSICS II YEAR III SEMESTER

**Practicals:**

### Subject: SIGNAL PROCESSING AND GEOPHYSICAL INVERSION

1. Computations on
2. Noise estimation using Auto and Cross Correlations.
3. Hilbert Transform.
4. Mellin Transform.
5. Amplitude and Phase Characteristics of Digital Filter.
6. Weiner filter.
7. Estimation of the epicentre coordinates of a seismic event.
8. Using least – square regression find the solution for experimental points assuming Gaussian uncertainties.
9. Two variables y and t are related through a linear relationship
    a. y = at + b determination of parameters a and b using experimental points
    b. ($y_i$ and ti ).
10. Some problems of error estimation.
11. Some problems on stability analysis.

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**Course: GP 356 F M. Sc. GEOPHYSICS II YEAR III-SEMESTER**

**Fieldwork:**

**Subject: GEOPHYSICAL FIELD PRACTICE-2**

## I. Gravity Methods

1. Acquaintance with Field Astatic Gravimeter their Operation & Procedure of measurement
2. Measurement of Static & Dynamic Drift.
3. Calibration of the Gravimeter
    a) Tower Experiment
    b) Tilt Method.
4.
    a) Establishment of Base Stations. Tying of Base Stations.
    b) Reduction and correction of Gravity Data II.

## II. Magnetic Methods

1 Acquaintance with Field Magnetometer & its Operation.

2 Measurement of Diurnal Variation

3 Establishment of Base station. Reduction of Magnetic data

4 Magnetic Profiling across a chosen Geological contact

## III. Electromagnetic Methods

a) Acquaintance with VLF equipment & Profiling with VLF to detect fractures

b) Profiling with GPR and Application of GPR in Groundwater Studies

**Note:** Fieldwork will be conducted in Osmania University Campus only. The fieldwork consists of Acquisition, Processing & Interpretation of data by the respective methods. At the end of the III semester II year, the students are required to submit 2 copies of Field Training Report on Geophysical Field Practice-2 to the Head, OU .The field reports area assessed by conducting a viva-voce consisting of (External examiner, HOD, Chairman BOS and the concerned teacher) a committee and the marks are awarded for their performance.

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**M. Sc. GEOPHYSICS II YEAR IV SEMESTER**

Scheme of Instructions and Examination (Effective from the Academic Year 2016-17)

**Theory: IV Semester**

| S. No. | Subject Code | Subject Theory | Instruction Hrs./Week | Exam. Duration | Max. Marks | | Total Marks | Credits |
|---|---|---|---|---|---|---|---|---|
| | | | | | Internal Asses. | Semester Exam | | |
| 1 | GP 401 T | Remote Sensing and GIS | 4 | 3 | 20 | 80 | 100 | 4 |
| 2 | GP 402 T | Well Logging | 4 | 3 | 20 | 80 | 100 | 4 |
| 3 | GP 403 T | **Electives:**<br>a. Mineral Exploration<br>b. Hydrocarbon Exploration<br>c. Radiometry and Nuclear Geophysics | 4 | 3 | 20 | 80 | 100 | 4 |
| 4 | CB GP 404 T | Groundwater Geophysics **(**Groundwater, Environmental and Engineering Geophysics) | 4 | 3 | 20 | 80 | 100 | 4 |
| | | **Total:** | **16** | | **80** | **320** | **400** | **16** |

**Practicals**

| Sl. No. | Subject. Code | Subject | Instruction Hrs./week | Exam. Duration | Total Marks | Credits |
|---|---|---|---|---|---|---|
| 5 | GP 451 P | Remote Sensing and GIS | 3 | 2 | 50 | 1 |
| 6 | GP 452 P | Well Logging | 3 | 2 | 50 | 1 |
| 7 | GP 453 P | **Electives:**<br>a. Mineral Exploration<br>b. Hydrocarbon Exploration<br>c. Radiometry and Nuclear Geophysics | 3 | 2 | 50 | 1 |
| 8 | CBGP 454 P | Groundwater Geophysics | 3 | 2 | 50 | 1 |
| 9. | GP 455 PW | Project Work | 6 | - | 100 | 4 |
| | | **Total:** | **18** | | **300** | **8** |

**Note:**

1. **Electives**: To be offered depending on the availability of facilities
2. Practical Examination will be conducted at the end of each Semester. Every Practical Examination will be of 50 marks.
3. **Project Work**: Students will be required to undertake a project work/dissertation during Fourth Semester. They must devote about 2-3 weeks' time either in the field and/or in laboratories for this purpose. The topic of their project work/dissertation will be decided towards the end of the Second Semester by the Head of the Department in consultation with the supervisor concerned. Provision of co-supervisor(s) will also be there. The related Lab. and/or Fieldwork may also be conducted during the summer vacation/intra/inter semester break. The Field Reports are assessed by conducting a viva- voce by a committee consisting of (External Examiner, HOD, Chairman, BOS and the concerned teacher) and the Marks are awarded for their performance.

## Course No. GP 401 T M. Sc. GEOPHYSICS II YEAR IV SEMESTER

## Subject: REMOTE SENSING and GIS

### Unit-I

**Principles of Remote Sensing:**

Electromagnetic Radiation (EMR) and its spectrum. Source of EMR and governing laws; interaction of EMR with atmosphere and surface of the earth. Atmospheric windows; spectral signature and spectral reflectance, spectral responses of vegetation, water, soil etc.

Remote Sensing Observation Platforms. Characteristics of remote sensing sensors: (spectral, spatial, temporal and radiometric resolutions).

**Satellites**:

Types of satellites, Data reception. Characteristics of the IRS, Remote sensing satellites.

### Unit-II

**Image Interpretation**: Principles of image interpretation, Visual image interpretation–image elements, geo-technical elements and visual interpretation aids.

Digital processing – Image enhancement, Image classification and image process systems. Advantages and limitations of visual and digital interpretation for geological studies.

Application of remote sensing in Geological and structural mapping.

General application of satellite data for various Geological, Groundwater, Mineral prospecting and Environmental impact and Hydrocarbon studies.

**Airborne Geophysical Methods:**

**Introduction**: Status of airborne geophysical methods.

Factors controlling airborne geophysical surveys. Characteristics and effective assemblage of airborne geophysical Surveys Advantages and disadvantage of airborne geophysical surveys

### Unit -III

**GIS:** Principles and application of geographic information system, introduction, definition and scope, components of GIS (hardware and software requirement for GIS application);

**Maps:** Maps and their different features/themes/layers, map projections-different types and their properties, GIS software in use; topology and attributes.

Datum Coordinate systems UTM, UPS and SPC system.

### Unit-IV

Definition and types of database, vector and raster data and their relative merits;

**Data management:** Data quality, data manipulation and analysis, advantages and disadvantages of database approach; Types of Input data –Digitizing, scanning; GPS system;

Introduction to Arc-GIS; GIS advantages in different fields.

Integration of RS and GIS data; GIS applications and recent trends.

**List of Recommended Books:**


1. Ward, S.H., 1967 Mining Geophysics, SEG Publ.
2. Floyd, F., Sabins, Jn., 1987, Remote Sensing Principles and Interpretation, W.H.Freeman, Company, New York.
3. Thomas, M. Lillesand, Raphw and Kiefer, 1987 Remote Sensing and image interpretation.
4. John Wiley & Sons, New York.
5. Paul, J Currian, 1988 Principles of Remote Sensing ELBS, London
6. Joseph Lintz, Jr. David, S. Simorelt, S, 1976 Remote sensing environment, Addisen-Wesly Publ. Co., Inc., Canada
7. Photo Geology-Miller, V.C., 1961 McGraw Hill, New York
8. Landsberg H.E., 1952advanced in Geophysics. Vol. I, Academic Press Inc., Publ. New York.
9. Landsberg H.E., 1969, Advanced in Geophysics Vol. 13, Academic Press Inc., Publ. New York.
10. Shiv Panedy 1987, Principles and Application of photo Geology, Wiley Eastern Ltd., New Delhi.
11. Rao, D.P., 1955 Remote sensing for Earth Resources, AEG Publ., Hyderabad.
12. Dr. G. Ramadass and Dr. D. Himabindu, 2001Prinples and Application of Remote Sensing.
13. Techniques in Mineral Groundwater and Oil& Gas Studies.

**Course No. GP 402 T M. Sc. GEOPHYSICS II YEAR IV SEMESTER**

**Subject: WELL LOGGING**

## Unit-I

Reservoirs characteristics and objectives of well logging. Reservoir Rocks: Clastic and carbonate rocks.

Reservoir Properties: Porosity, permeability, fluid saturation, need of drilling fluids & their properties.

Borehole environment- invasion process and various profiles. Classification of well logging methods,

Spontaneous Potential (SP) logging: Spontaneous potentials in boreholes and its sources. SSP and its measurements. SP curves and its interpretation, factors affecting the shape and amplitude of SP curve. Determination of formation water resistivity from SP logs.

## Unit-II

Principles of non-focussed resistivity logging: Single Point Resistance (SPR) log, Conventional (normal, lateral) resistivity logs and their response across a layer of anomalous resistivity

Principles of operations of Focused current logs: Laterolog-3, Laterolog-7 and Dual Laterolog. Pseudo geometrical factor, environmental corrections. Interpretation of Laterologs. Principles of Micro Resistivity (Wall) logging. micro-normal, micro-lateral and focused micro logs and applications. The Induction log principles, Geometric theory, Dual Induction Focussed Logs and its uses.

## Unit-III

Radioactivity and Nuclear Logging Methods**:** Principle of natural gamma logging – Causes of natural radioactivity in Rocks and use of gamma logs for lithological & shaliness identification. Spectral Gamma Ray log & uses.

Principle of gamma-gamma (density) logging, Litho-Density tool (LDT) - Compensated Density tool (CDL) and their uses. Principles of Neutron–Neutron logs and their uses. Acoustic (sonic) logging-Principle and uses. Thermal, Calliper logging and their applications.

## Unit-IV

Field Instrumentation for Geophysical Logging and Field Procedures.

Well log interpretation - Quick look techniques, Hingle, Pickett& M-N cross plots, saturation estimation, lithology, porosity (primary and secondary) determination, Log interpretation case studies. Sub-surface correlation and mapping from log data. Production logging.

Application of Well logging for (a) Groundwater, (b) Ore Minerals, (c)Petroleum & Gas.

**List of Recommended Books:**


1. Serra, 1984, Fundamentals of well log interpretation-1.The acquisition of Logging data. Elsevier Science Publishers, B.V.
2. Serra, 1986, fundamentals of well log interpretation-2.The acquisition of Logging data. Elsevier Science Publishers, B.V.
3. Vaish, J.P.1997, Geophysical Well logging: Principles and practices, Asian Books PVT Ltd., New Delhi.
4. John T.Dewan,1983, Essential of Modern open –hole log interpretation, Pennwell Books, Pennwell Publ. Co., Tusla, Oklahoma
5. Brock, James.G.1986. Applied open – hole log analysis, Gulf Publ. Co., Houston, Texas
6. Itenberg, S.S. 1971, Study of oil and gas series from Well logs, Mir. Pub. Moscow.
7. Schlumberger, 1972, Essential of log interpretation Practice. Schlumberger., France
8. Schlumberger, 1969, Log interpretation Principles and charts, Schlumberger. Ltd., USA.
9. Ed.J.Lynch .,1964, Formation and evaluation, Harper and Row , Japan and US.
10. Syllvin, J, Pirson, 1963. Hand Book of Well log Analysis, Prentice, Hall, Inc.
11. Borehole Geophysics Applied to Ground water investigations by W.Scott Keys.US Geological Survey Open File Report, 87-539.
12. Dresser Atlas, 1982 Well Logging and Interpretation techniques - Dresser Industries Inc
13. The Geological Interpretation of Well Logs by M.H.Rider-1986.

**Elective:**

**Course No. GP 403 T (a) M. Sc. GEOPHYSICS II YEAR IV SEMESTER**

**Subject: MINERAL EXPLORATION**

## Unit-I

Different types of mineral deposits and associated ore minerals, Stratigraphic, Lithologic and structural controls of mineralization and their significance in geophysical prospecting Problems in exploration geophysics, location, depth, dimension and extension of ore bodies.

## Unit-II

Gravity, Magnetic, and Radiometric surveys in surface exploration for mineral deposits. Scales of surveys. Density of data collection, field procedures, data corrections and error. Some case histories and interpretation concept.

## Unit -III.

Electrical and electromagnetic methods, well-logging in mineral exploration. Special techniques and analysis of data. The importance of seismic, thermal and other methods in mineral prospecting. Suitable case histories with their data processing and interpretation. Special techniques and procedures used in subsurface geophysical exploration by geophysical methods.

## Unit –IV

Integrated approach in geophysical exploration for mineral deposits. Optimization of exploration strategy. Computer applications in processing and interpretation of geophysical data. Application of GIS in mapping reserves and estimation.(Base metals, ferrous, precious and non-metallic ore deposits, placer deposits, Uranium deposits etc.)

**List of Recommended Books:**


1. Introduction to mineral exploration, Author M.EVANS
2. Mining Geophysics, DS. Parasnis.
3. Introduction to Mineral Exploration by Charles J, Moon, MKG Whatel

**Elective:**

**Course No. GP403 T (b) M. Sc. GEOPHYSICS II YEAR IV SEMESTER**

**Subject: HYDROCARBON EXPLORATION**

**Unit-I**

Petroleum Geology: Types of Hydrocarbons - Heavy and Light oils, Natural Gas, Condensates; Elements of Petroleum system - Source Rock-GME cycle (Generation, Migration and Entrapment); Reservoir rocks - Clastic and Carbonate reservoirs; Types of Seal/ Cap rocks; Structural and Stratigraphic traps.

Habitat of hydrocarbons in sedimentary basins - Basin evolution, structural styles and plate tectonic habitats, distribution of hydrocarbons within a basin.

**Unit-II**

Exploration methodology: Gravity, Magnetic, Seismic, Electrical and Electromagnetic methods in the search of Hydrocarbons in Frontier and explored areas.

Seismic Stratigraphy: Principles of seismic stratigraphy, Depositional history reconstruction, Use of wells logs in lithology identification and facies analysis;

**Unit-III**

Seismic-well ties: VSP/ check shot data, Synthetic Seismogram.

Interpretation of 2D & 3D seismic data: Use of Interactive Interpretation Work Stations: Analysis of Inline, 'X'(Cross)line and Arbitrary lines and Time slices, Horizon correlation, misties, Fault Interpretation, Preparation of Isochron/Isopach Maps, Role of Seismic attributes and horizon slices in 3D interpretation. Impedance Inversion, Pitfalls in structural interpretation.

**Unit-IV**

Prospect analysis - Risk assessment and Resource estimation.

Direct detection of oil and gas deposits: Oil seeps, DHI, AVO, Seismic Attributes, Velocity Anomalies, Gas Chimneys, Pock marks.

Special topics: Time Lapse 3D, Gas Hydrates, Shale Oil/Gas exploration.

**List of Recommended Books:**


1. Richard C Selley, 1983: Petroleum Geology for Geophysicists and Engineers, IHRDC, USA.
2. Milton B Dobrin and Carl H Savit, 1988, Geophysical Prospecting (Fourth Edition) – McGraw-Hill Book Company.
3. RE Sherif and H Savit : Exploration Geophysics
4. Nigel Anstey, 1977 Seismic Interpretation - The Physical Aspects. IHRDC
5. Alistair Brown, 2010 Interpretation of Three Dimensional Seismic Data, AAPG Memoir 42/ SEG Investigations in Geophysics No.9.
6. Geophysics, The Leading Edge of Exploration issues of SEG

**Elective:**

**Course No. GP403T (c) M. Sc. GEOPHYSICS II YEAR IV SEMESTER**

**Subject: RADIOMETRY AND NUCLEAR GEOPHYSICS**

**UNIT- I**

Radioactivity: Introductory.

General remarks on radiometric and nuclear geophysical methods. Brief review of radioactive transformations and equilibrium. Natural and artificial radioactive elements. Stable and radioactive isotopes in nature.

Radiation Sources, Units of Radioactivity, Gamma and X-radiation sources generator and nuclear reactor. Isotopic neutron sources generator and nuclear reactor as a source of neutrons.

Elementary concepts of safety considerations in handling of gamma and neutron sources.

**UNIT-II**

Radiation detectors and basic equipment's: Geiger-Muller and proportional counters, scintillation detectors-NaI (TI) gamma ray spectrometer. Outlines of semiconductor radiation detectors. Elements of neutron detectors.

Principles of counting systems - total and differential counting, Basic principles of alpha, beta and gamma methods.

Laboratory Radiometric analysis: Beta gamma method. Gamma spectrometric technique for U, Th, K determinations. Alpha spectral analysis, Emanation methods of analysis. Application of radiometric methods for radioactive and non-radioactive ores.

**UNIT-III**

Brief revision of radiometric methods. Evaluation of anomalies,

Gamma radiation techniques in Nuclear Geophysics: Gamma absorption method for a determination of rock densities and estimation of total heavy elements. Gamma scatter principle for the estimation of insitu densities and ore as saying. Field applications of method in mine workings and boreholes.

**UNIT-IV**

Neutron methods: Neutron-Neutron absorption and scatter principles. Field applications for moisture and porosity estimations.

Principles of application of the n-gamma method for determinations of elements such a Fe, Cr, Ni, Cl in the laboratory and in logging investigations.

Summary and Revision of gamma and neutron techniques.

**List of Recommended Books:**


1. VLS Bhimasankaram, N. Venkat Rao, K. Sreeramamurti and EI Savenko (1985) Principles and Methods of Nuclear Geophysics, Published by AEG.
2. VLS Bhimasankaram (1974) Radiometric methods of Exploration, Published by CEG.
3. VLS Bhimasankaram, EI Savenko, and N. Venkat Rao (1973) Laboratory and field Methods of radiometry and nuclear geophysics, published by CEG.
4. W.M. Telford, L.P. Geldart and R.E. Sheriff (1990) Applied Geophysics published by Cambridge University Press.

**Course No. GP404 T CB M. Sc. GEOPHYSICS II YEAR IV SEMESTER**

**Subject: GROUNDWATER GEOPHYSICS**

**(**Groundwater, Environmental and Engineering Geophysics)

## Unit I

Importance of Groundwater, Hydrologic cycle, subsurface water and its distribution, classification of rocks as aquifers. Groundwater Provinces of India. Role of geophysical methods in solving hydro geological problems. . Artificial recharge- Need for artificial recharge – Recharge Methods – Geophysical Methods for site selection for recharge operations .

## Unit II

Different types of environmental pollutants, Landfills, Waste disposal- Industrial waste, mining activity, nuclear waste, etc. Causes of Groundwater pollution: Industrial, geological ,sea water intrusion and major engineering projects. Effects of Environmental pollution on the human body and human civilization. Water – logging courses – geophysical studies for water logged areas with a view to reclamations.

## Unit III

**Engineering properties of soils and rocks:** Characteristics of important engineering problems – landslides, tunnels, cavities, roads etc., foundation and archaeological problems. Landslides – types of mass movements, identifications of land slide zones. Characteristics of near surface geophysical Investigations, types of methods used, scales of survey and peculiarities of near surface geophysics.

## Unit IV

Application of Geophysical methods in solving Groundwater problems. Case studies in soft and hard rock areas. Delineation of salt & fresh water boundary.

Application of geophysical methods in foundation and road investigations (depth, aerial extent, fractures, rippability etc.), case studies

Application of Geophysical methods in solving environmental problems, case studies.

## List of Recommended Books:


1. Murali, S. and N.S. Pathangay, 1998, Principles and applications of ground water geophysics, AEG. Publications, Hyderabad.
2. Kelly, KE. and Mares, S., 1993, Applied Geophysics in Hydro Geological and Engineering Practice, Elseiver , Amsterdam.
3. P.V.Sarma, 1986, Geophysical methods in Geology.
4. Lillesand, T.M. and R.W. Keiffer, 1994, Remote Sensing and Image Interpretation, John Wiley & Sons.
5. Karant, K. 1987, Ground water assessment, development and management data. Mc GrawHill, New Delhi.
6. Mares. S, 1984. Introduction to Applied Geophysics, D. Redial, Publishing Co., Dordrecht.
7. John M. Reynolds 2011.An Introduction to Applied and Environmental Geophysics.

**Course No. GP 451 P M. Sc. GEOPHYSICS II YEAR IV SEMESTER**

**Practicals:**

**Subject: REMOTE SENSING and GIS**

1. Generation of image from digital data.
2. Identification of Spectral signatures of different ground features from the image.
3. Identification of features like tone, texture, pattern on satellite Images for Interpretation.
4. Applications of Remote Sensing techniques to
    a. Geological Mapping.
    b. Groundwater studies.
    c. Oil and Gas studies.
5. Qualitative and quantitative Interpretation of Airborne Gravity and Magnetic data

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**Course No. GP 452 P M. Sc. GEOPHYSICS II YEAR IV SEMESTER**

**Practicals:**

**Subject: WELL LOGGING**

1. Demarcation of bed boundaries from the given (a) Electrical resistivity – Potential and Gradient logs.(b) S.P.Logs.
2. Determination of resistivity of formation water from S.P Log.
3. Determination of true resistivity using nomograms.
4. Interpretation of micrologs.
5. Determination of (a) radioactive beds and their percentages of radioactivity (b) Shaliness from natural gamma ray log.
6. Demarcation of bed Boundaries and identification of lithological Units from the complex geophysical logs of. (a) Hard rock Terrain, b) Soft rock Terrain.
7. Demarcation of bed boundaries and identification of aquifer horizons for groundwater utilization from well log data.
8. Demarcation of bed boundaries and identification of mineralized zones from well log data.
9. Demarcation of bed boundaries and identification of oil and gas horizons from well log data.
10. Computation of following Reservoir properties from well log data (a) Formation Factor, (b) Porosity from Resistivity, Density, Neutron & Acoustic Logs(c) Water Saturation (d) Hydrocarbon Saturation

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**Elective**

**Course No.GP453 P (a) M. Sc. GEOPHYSICS II YEAR IV SEMESTER**

**Practicals**

**Subject: MINERAL EXPLORATION**

1. Study of the characteristics features of various minerals anomalies of different geophysical methods Gravity/magnetic, electrical and E.M methods
2. Interpretation and processing of associated anomalies
3. Collection of radioactive and other mineral samples
4. Laboratory measurements of minerals associated properties like Density /electrical/ radioactive and magnetic.
5. Acquaintance with modern mineral exploration processing software.

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**Elective:**

**Course No.GP 453(b) M. Sc. GEOPHYSICS II YEAR IV SEMESTER**

**Practicals**

**Subject: HYDROCARBON EXPLORATION**

1) Computation of Interval, Average and RMS Velocities from Check shot data.
2) Identification of structural and stratigraphic features on seismic sections (Manual).
3) Contouring exercises over different structural and stratigraphic features (structural highs, faults, wedge-out, etc.).
4) Horizon correlation, timing and contouring (Manual).
5) Interpretation on Interactive Interpretation Workstations -2D seismic.
6) Interpretation on Interactive Interpretation Workstation-3D Seismic.
7) Gridding and Mapping, Analysing Isochron maps.
8) Depositional history reconstruction by Structural Restoration through Horizon flattening on 2D seismic.
9) Computation of HC Resources/ Reserves.

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**Elective:**

**Course No.GP 453(c) M. Sc. GEOPHYSICS II YEAR IV SEMESTER**

**Practicals**

**Subject: RADIOMETRY and NUCLEAR GEOPHYSICS**

1. Problems on basics of radioactivity related to the calculation of radiation activities, units, attenuation of gamma radiation, principles of counting statistics, errors of radiation measurements.
2. Problems on laboratory radiometric practice – Estimations of U-Ra and U-Th by beta – gamma method and U, Th, K determinations by gamma spectrometry.
3. Calculation of gamma intensities of ore bodies – evaluation of concentration of an ore body from measured intensity anomalies.
4. Calculation of effective atomic numbers for some rooks/ores for different predominant processes of gamma-ray interaction.
5. Determination of parameters of neutron activation analysis.

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**Course No. CBGP 454 P M. Sc. GEOPHYSICS II YEAR IV SEMESTER**

**Practicals:**

**Subject: GROUNDWATER and ENVIRONMENTAL GEOPHYSICS**

1. Interpretation of VES data, in solving hydrogeological problems (a) Hard rocks, (b) Sedimentary area.
2. Exercise on relation between electrical conductivity and TDS.
3. Computation of engineering properties of rocks and rip ability from the P&S wave velocities.
4. Mapping the structure and the basement fractures using seismic data.
5. Determination of Groundwater salinity from VES data.
6. Estimation of Coefficient of electrical anisotropy from the resistivity log data.
7. Interpretation of T.S. values from pump test data using Jacob's method.

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