

M.Sc (Tech.) Geophysics

GS-101 GEOLOGY – I

- UNIT I: Origin of Earth, Branches of Geology, Interior and Exterior of the Earth. Weathering phenomenon, Geological work of wind : various erosional and depositional features of wind like hannadas, yardangs, lag deposits, loess, sand dunes, types of sand dunes, structure of stationary and migrating dunes, pedestal rocks and oasis.
- UNIT II: Geological work of rivers : their development-meandering-causes of meandering-oxbow lakes-flood plains-peneplains-natural levees-aluvial fans and alluvial cones-talus slopes, scree deposits and deltas. Geological work of glaciers: various erosional and depositional features of glaciers. Earthquakes, volcanoes. Geological work of sea: Shorelines – bays – near shore destructive work of sea. Shallow and deep marine sedimentary environment. Sedimentary processes: mechanical and chemical weathering, biochemical processes, sedimentary facies – development and their uses in understanding depositional processes.
- UNIT III: Fundamental concepts of geomorphology. Topographical features due to wind, rivers and glaciers. Kart topography. Various morphological features caused due to internal dynamic processes by earthquakes and volcanoes. Soil types and their classifications. Topographic maps.
- UNIT IV: Definition of petrology. Differentiation of Igneous, Sedimentary and Metamorphic rocks. Origin and forms of Igneous rocks, textures-structures and classification of igneous rocks. Origin and forms of sedimentary rocks, textures-structures and classification of sedimentary rocks. Types of Metamorphic rocks. Textures and structures of Metamorphic rocks.
- UNIT V: Physical, chemical and optical properties of minerals. Classification of feldspar, mica, pyroxenes, amphiboles and garnet groups. Clay minerals. Elements of crystallography, crystallographic axes, symmetry form of crystals and classification of crystals.

Books:

1. Physical Geology, G.Gorshkov, A.Yakushova
2. Physical geology, A.K.Datta
3. A textbook of Geology, P. K Mukherjee.
4. The principles of petrology, G.W.Tyrell.
5. Rutleys mineralogy, H.M.Read
6. Physical Geology, Arthur Holmes
7. Physical and Engineering Geology: S.K. Garg
8. A textbook of Gaeology: G.B. Mahapatra
9. Engineering and general geology: Parbin Singh

GS 102: COMPUTER PROGRAMMING & NUMERICAL ANALYSIS

Unit I: Introduction: General architecture of a computer. Types of computers. Advantage of digital computers, structure of a computer, programming languages, object program, compilers and assemblers. Number Systems, Binary arithmetic, Algorithm, Flowchart, Low level and High Level Languages, Integer and Floating Point Arithmetic.

Unit II: Computer Operating systems: Different types of operating systems: Single user operating System- MSDOS; Basic structure of DOS, DOS commands, Control-Function keys. DOS editing keys. Formatting etc.; Multi-tasking operating system- MS WINDOWS, Basic concepts of windows. Advantages of WINDOWS over MSDOS; Multi-user and multi-tasking operating systems- UNIX, File system in UNIX, File mangement, UNIX commands and Shell programming.

Unit III: Structure of FORTRAN-77, programming preliminaries, Constant and Variables, expressions- Statements Library functions, Control statements - GOTO, Logical expressions, DO statement & Nesting, STOP, END and PAUSE statements; subscripted variables. Arrays and DIMENSION statement; Special statements - COMMON, DATA statements. Input and Output statements; Subprograms –SAVE & EQUIVALANCE, Function and Subroutines Double Precision.

Unit IV: C programming language: Basic concepts of C; Symbolic and arithmetic constants and variables; Data types in C Decision control. Loop control and Case control structures in C; Functions; Pointers and Arrays; Input and Output; Iteration with Hardware through C and Operations on Bits; Some selected Geophysical problems and their C programs.

Unit –V: Programming Examples both in Fortran and C-Languages to handle,
Geophysical Problems like - Calculation of normal Gravity, Gravity
Anomalies of Spheres and Horizontal Cylinders, Magnetic Anomalies of
Point Dipole, Dykes, Faults and Sheets Refraction hodograph-2 Layer
Earth- Practicing these programmes using control statements, SUB
ROUTINES, I/O Statements and Nesting.

Books:

1. Fortran programming. A.K. Jain & M.N.Kesava Rao
2. Fortran 77 programming, V.Rajaraman ,
3. Let us C, Yashavant Kanetkar
4. UNIX shell programming , Yashavant Kanetkar

GS 103: PHYSICS OF THE EARTH

- Unit I:** Origin of the earth- the Universe and our galaxy, chemical evolution of galaxy formation of the earth and planets, primary differentiation of the earth. Composition of the various zones, abundance of elements in the earth, the rotation of the earth, the moon, salient concepts of plate tectonics.
- Unit II:** The earth's gravity field, the force of gravity on the surface of the earth, the figure of the earth, Clairaut's theorem, the geometric and gravitational flatten! International gravity formula, geoid and spheroid, the gravity potent establishment of gravity bases, drift correction, reduction of gravity data, free and Bouguer anomalies, Isostasy - Pratt - Hayford, Airy - Heiskanen system anomalies.
- Unit III:** Geochronology, Radioactive decay. Dating of rocks - potassium-argon – rubidium strontium-uranium-lead-carbon 14 methods, age of the earth. The earth's thermal properties, the basic thermal data, the measurement of terrestrial flow, calculation and analysis of heat flow rate, heat flow over the ocean floor, flow over continents, sources of heat in the earth, temperature distribution in earth. The equality of continental and oceanic heat flows, regions of anomalous flow, hot spots, relation ship of heat flow to the radioactivity of the earth.
- Unit IV:** Formation of surface water resources, streams, rivers, lakes, swamps, caves, seas and oceans. Definition of river, river basin and water divide. formation of river values, sediment discharge, sediment transportation, sediment yield of watersheds, suspended load and bed load measurements, Runoff, Disposition of total precipitation to total runoff, runoff phenomena, factors affecting runoff, and estimation of runoff. Types of current meters, velocity measurements by current meters, floats, and velocity rod. Methods of discharge estimation.
- Unit V:** Hydrographs: Discharge of hydrograph, features of a hydrograph, factor affecting shape of hydrograph, components of hydrograph, base flow separation methods. Unit-hydrograph Principle of unit, application of unit hydrograph, S-hydrograph, Dimensionless unit hydrographs. Floods, design flood, maximum probable flood, flood control methods, flood frequency methods, flood routing methods, flood forecasting techniques.

Books:

1. Introduction of Geophysics, Howell
2. Physics and Geology, Jacobs and Russel
3. Physics of the earth, Stacy
4. The interior of the earth, M.H.P. Bott
5. Topics in Geophysics, P.J. Smith
6. Fundamentals of Geophysics, William Lowrie
7. Groundwater Hydrology, D.K. Todd
8. General Climatology, HJ. Critchfield
9. Earth, Press & Siever
10. A text book of Hydrology, Dr.P.Jayarami Reddy
11. Hand Book of Applied Hydrology, Ven Te Chow (ed.)
12. Applied Hydrology, R.K.Linsley, M. A. Kohler & Paulhus
13. Engineering Hydrology, R.S. Varshney
14. Engineering Hydrology, E.M. Wilson
15. Hydrology and Water Resources Engineering, R.K. Sharma & T.K. Sharma
16. A Textbook of Geology, P.K.Mukherjee
17. Applied Hydrology, K.N. Muthreja
18. Handbook on the Principles of Hydrology, Donald M Grey
19. Facets of Hydrology , John C Rodda
20. A textbook of Hydrology , Dr. P. Jayaramireddy

GS-104 SEISMOLOGY

- Unit I:** Introduction to seismology. Earthquakes and Plate Tectonics: Plate kinematics, Spreading centers, and Subduction zones. Oceanic interplate seismicity, Continental earthquakes and tectonics. Faulting and Fracture, Secondary effects of earthquakes: landslides, tsunami, fires and fatalities, Seismicity of India and Globe, Seismic zoning. Earthquake effects and hazards. Elastic waves- Elastic, Anelastic and Plastic behavior of materials. Stress, Strain, elastic constants. Seismic waves- Introduction, Body waves. Surface Waves, Types and Phases of waves. Free oscillations of the Earth, the internal Structure of the Earth- Refraction and Reflection in the earth's interior. Types of Earthquakes.
- Unit II:** Seismometry: Introduction, Principle of Seismometer, Vertical motion seismometer, and Horizontal motion seismometer. Broad Band seismometer, Analog recorders. Digital recorders, Seismogram- Identification of Phases on a seismogram. Selection of seismograph stations. Global seismic network
- Unit III:** Seismic Sources - Faults, Introduction of earthquake focal mechanism, Single- Couple and Double couple radiation patterns. Fault-plane solutions. Mechanics of faulting, Travel-Time curves, locating earthquakes.
- Unit IV:** Seismogram Interpretation, Earthquake intensity Magnitude, Frequency, Energy released in an earthquake. Epicenter determination. Analysis of earthquake focal Mechanism.
- Unit V:** Micro earthquakes- Analysis and interpretation of seismograms, Reservoir induced earthquakes. Prediction of location of the earthquake. Earthquake control. Monitoring of Nuclear explosions.

Books:

1. Fundamentals of Geophysics, William Lowrie
2. Modern Global Seismology, Thorne Lay
3. Earthquakes, Bolt, B.A.,
4. Introduction to Seismology, Perry Byrle
5. The Earth, Jeffreys.S.H.
6. Elementary Seismology, Charles.F. Richter
7. Earthquake Mechanics, Kasahara. K.
8. The Mechanics of Earthquakes-faulting, Scholtz.C.H.
9. An introduction to the theory of seismology, Bullen. K.E.
10. Quantitative seismology: theory & methods, Aki. K. and Richards. P.G

GS-201 GEOLOGY – II

- UNIT I: Stratigraphy and its importance. Physiographic divisions of India. Geological time scale, Principles of correlation. Fossils and their importance in stratigraphy.
- UNIT II: Outlines of important Indian groups and systems: Archean-Dharwar-Cuddapah-Vindhyan-Gondwana Group-Deccan traps-Siwaliks. Quaternary formations.
- UNIT III: Structural features of rocks. Stress and strain. Primary and secondary structures – dip and strike. Folds: Introduction – Classification – Origin. Faults : Introduction – Classification – Recognition. Causes of faulting. Joints: Introduction – classification – Origin. Unconformities: Definition – Origin – Types. Diapirs and related structural features, significance – micro structures, onlap, offlap, inliers, outliers, schistosity, lineation, foliation-significance.
- UNIT IV: Economic mineral deposits: origin of ore deposits – igneous, sedimentary and metamorphic rock types – Metallic and Non metallic ore types. Placer minerals, Classification of coals, Origin, migration and entrapment of petroleum deposits – KG basin.
- UNIT V: Physiography and divisions of seas and world oceans. Continental margin, littoral zone, continental shelf, continental slope, continental rise, deep sea, seamounts and guyots, abyssal plains. Mid-oceanic ridge system. Coral reefs and their formation. Island arcs. Deep sea sediments, placers on the beach and shelves, conditions for formation of polymetallic nodules. Law of the seas.

Books :

1. Physical and engineering geology: S.K. Garg
2. A text book of geology: G.B. Mahapatra
3. Engineering and general geology: Parbin Singh
4. Sub marine geology, P.H.Kunen
5. Submarine geology, F.P.Sheppard.
6. Stratigraphy of India, M.S.Krishnan
7. Structural Geology, M.P.Billings
8. Economic mineral deposits, A-M.Bateman and M.N.Jenson

GS -202: GEOMAGNETISM

- Unit I:** The main magnetic field, magnetic observatories, Instruments - proton precision magneto meter, magnetic elements, magnetic charts, the magnetic dipole, the magnetic field of an electric current, separation of magnetic fields of external and internal origin, the magnetic field of the external origin, ionosphere, magnetosphere, diurnal variations of magnetic field, Sq and L variations, magnetic storms and Aurora.
- Unit II:** The magnetic field of the internal origin, IGRF, the dipole field, the non – dipole field, secular variation and west ward drift, magnetic fields of the Sun, Moon and planets, theories on the origin of earth's magnetic field, the permanent magnet hypothesis, Blakett's theory, the earth as a dynamo, the disc dynamo, dynamo of Lowes and Wilkinson.
- Unit III:** Magnetic properties of rocks, dia, para and ferromagnetism, the ternary oxide system of magnetic minerals, the titanomagnetite series, the titanohematite series, other ferromagnetic minerals. Magnetic susceptibility of rocks, NRM in rocks, measuring instruments. Spinner magnetometer, Cryogenic magnetometers.
- Unit IV:** Palaeomagnetism, remanant magnetism in rocks, TRM, DRM, CRM, VRM, hysteresis curve. Isolation of remnance, cleaning methods. AF demagnetization, thermal demagnetization, laboratory procedure, tests for stability.
- Unit V:** Reversals of the magnetic field, polarity of the geomagnetic field, geomagnetic scale, projective method of presenting palaeomagnetic data, magnetic latitude and co - latitude, calculation of mean direction of virtual geomagnetic poles, palaeomagnetic poles, reconstruction of palaeomagnetic poles, continental drift, northward drift of India, results from different continents.

Books

1. Debate about the Earth, H. takenchi, S. Uyeda and H. Kanamori
2. Fundamentals of Geophysics, William Lowrie
3. Geomagnetism, Sydney Chapman
4. Application of Palaeomagnetism, E. Erwing
5. Palaeomagnetism and Continents, J D A Piper
6. Palaomagnetism and Plate tectonics, M W McElhimy

GS 203 GEODYNAMICS

- UNIT I Continental drift: Super continents, Gondwana land and its break up, Geophysical Evidences for continental drift and drift of India, Indian Ocean floor its evolution and active lithospheric processes.
- UNIT II *Plate Tectonics*: The lithosphere, Distribution of Plates, Major and Minor plates, Kinds of Plate Margins- Constructive, destructive and conservative plates, Characteristics and processes at accreting and consuming plate boundaries, Stability and stress distribution with in plates, active and passive continental margins, marginal basins, transform faults.
- UNIT III Differences between plate tectonics and continental Drift, magnetostratigraphy, paleomagnetism, Plate tectonics and mountain building, relative motion of the plates, Methods of measuring plate motions, Causes of plate motions, Eulers pole of rotation, Forces acting on the lithospheric plates, the Wilson cycle, Continental collisions, seismicity and Intraplate earthquakes.
- UNIT IV Eustatic movements, Evidences of sealevel changes, Global sea level changes, sea level changes during the Quaternary period, Pre-quaternary sea level changes, Mechanism of sea level change, Impact of sea level changes. Brief description of structure and composition of the oceanic and continental crusts, upper and lower mantle and core (inner and outer), Rheological effects of lithosphere, Brittle and ductile deformation, creep mechanism in the earth, Rigidity of Lithosphere, flexure of plates and compensation models in lithospheric studies. Stresses in the Lithosphere and their sources.
- UNIT V Convection: Mantle viscosity, Concepts of mantle convection Models, Coupling between plates and mantle convection, Hot spots and Mantle plumes, Plume generation Mechanism, Evidence for mantle plumes from seismology and Geoid, Deep Continental structure of India-Sources of data, Suggested crustal column, seismic velocity structure, Heat flow and seismicity structure, evaluation of tectonic stress, Plate tectonics and evolution of Himalayas, models based on gravity, DSS data and seismicity (Brief description only).

Books:

1. Plate tectonics and geomagnetic Reversals, Allan Cox, Free Man and Company, 1973.
2. Developments in Geotectonics, Xavier Le Pichon, Jean Francheteau and Jean Bonnin, Elsevier Scientific Publishing Company, 1973.
3. The earths Dybnameic Surface, K Siddhartha, Kishalaya Pub Pvt. Ltd. 1999
4. Fundamentals of Geophysics, William Lowrie, Cambridge Low Price Edition, 1997.
5. Geodynamics by Turcotte
6. Interior of Earth by M.H.P. Bott
7. The Encyclopedia of Solid Earth Geophysics by David E. James
8. Plate Tectonics and Crustal Evolution by Kent C. Condie
9. Deep Continental structure of India: A review, T.M.Mahadevan, Memoir 28, Geological Society of India, 1994.
10. Geodynamics of the Indian Peninsula and the Indian Plate Margin, R.K.Verma, Oxford & IBH Publishing Co. Pvt. Ltd, 1991.
11. Gravity field, seismicity and tectonics of Indian peninsula and the Himalayas by R.K. Verma

GS 204: MAGNETIC METHOD

UNIT I Earth's main magnetic field, origin and temporal variations (outlines only), Geomagnetic elements, Vectorial representation, spatial variation, Basic concepts, Coulombs law of magnetic force and fields, magnetic moments, intensity of magnetization and induction, magnetic potential and its relation to field, units of measurement, origin of magnetic anomalies, interrelationship between different component anomalies, Poisson's relation, Magnetic susceptibility, factors controlling susceptibility, magnetic classification of minerals and rocks, Laboratory and in-situ methods of determining susceptibility, Natural remanent magnetism, Astatic and Spinner Magnetometers, demagnetization effects,

UNIT II Principle of magnetic prospecting, Instruments - Nuclear, fluxgate, Squid's and optical pumping magnetometers, gradient measurements, Plan of magnetic surveys in different mineral exploration programs, Magnetic data reduction, diurnal and normal corrections, IGRF, Airborne magnetometry, orientation mechanisms, survey techniques, data acquisition and reduction, Advantages and disadvantages, brief principles of ship-borne and satellite magnetometry

UNIT III Interpretation of magnetic data, qualitative interpretation, nature of anomalies, identification of different structural features. – Dependence of magnetic anomalies on latitude and orientation. Isolation and enhancement of anomalies using graphical, trend surface analysis, digital filtering, reduction to pole filter, derivative and continuation filters (Brief descriptions), Ambiguity in magnetic interpretation, generalized approach of interpretation.

UNIT IV Magnetic anomalies (vertical and total field) of single poles and sphere, anomaly equations, profiles, properties and interpretation procedures. Similarity of magnetic anomalies of two dimensional bodies in different components – generalized equations for the magnetic anomalies of line dipoles, dykes, sheets and faults, profile shapes and interpretation by thumb rules and characteristic curves, ambiguity in interpretation of magnetized dyke, Koloumzine method, Forward modelling of magnetic anomalies: Gulatee's rule, two dimensional and three-dimensional bodies of arbitrary shape, use of graticules, Computer models, familiarization of anomaly equations,

UNIT V Principles of inversion, Inversion of magnetic anomalies of 2D polygonal bodies, magnetic anomalies of dykes and magnetic interfaces - Frequency domain interpretation: Use of Fourier transforms in magnetic interpretation with special reference to dykes and faults, end corrections, use of Hilbert transforms, Relation figures, brief interpretation procedures of MAGSAT anomalies- Application of magnetic method for regional geological mapping, oil exploration, mineral exploration, ground water and Engineering problems.

Books:

1. Gravity and magnetics in oil prospecting, L.L.Nettleton
2. Gravity and magnetic methods, Rao, B.S.R and Murthy, I.V.R
3. Gravity and magnetic Interpretation in Exploration Geophysics, I.V.Radhakrishna Murthy
4. Applied Geophysics, W.W.Telford et. al
5. Introduction to Geophysical prospecting, M.B.Dobrin
6. Interpretation theory in Applied Geophysics, F.S.Grant and West
7. Special issue on Geomagnetic methods and Lithospheric structure, Proc. Of Earth and Planetary Sciences, Indian Academy of Sciences, Vol.99 (4),1990.

GS 301: GRAVITY METHOD

- Unit I Earth's Gravity field, Properties of Newtonian potential, Laplace's and Poissons's equations, Green's theorem, Gauss law, continuation integral, equivalent stratum, spatial and temporal variations, Principle of gravity prospecting, concept of gravity anomaly. Rock densities, factors controlling rock densities, Bouguer density, Insitu determinations, Borehole methods. Gravity prospecting instruments – Static gravimeters, Astatization, Zero-length spring, Worden & Lacoste Romberg Gravimeters.
- Unit II Plan of Gravity surveys – mineral exploration, oil prospecting and Geological mapping, Establishment of gravity bases, Reduction of gravity data – Normal, Bouguer, Free Air, Topographic corrections, Drift correction. Problems in airborne and shipborne gravimetry, horizontal and vertical accelerations, Eotvos correction. Interpretation of gravity data – Qualitative interpretation, identification of structural features and litho contacts, two-dimensional and three-dimensional bodies - nature of anomalies.
- Unit III Regional and residual separation – graphical, average, grid and curve fitting methods, reliability of different types of residuals, use of filters, vertical derivative calculations, upward and downward continuation of anomalies, classical methods using continuation integral, employing harmonic analysis and Fourier Transformation.
- Unit IV Ambiguity in gravity interpretation, classical method of interpretation, gravity anomalies of point and line masses, circular discs, vertical cylinders, sheets, faults and rectangular slabs, Characteristics of anomalies, properties, interpretation by simple thumb rules and characteristic curves. Forward modeling of gravity anomalies of two-dimensional and three-dimensional bodies of arbitrary shape, Graticules, computer models, anomalies of two-and-half-dimensional bodies.
- Unit V Inversion of gravity anomalies of 2-D polygonal bodies, Automatic gravity modeling of sedimentary basins and density interfaces by Bott's method. Modeling of gravity anomalies using linear, exponential and quadratic density contrast. Use of Fourier Transforms in Gravity interpretation, Mass estimation in gravity. Application of gravity methods for regional geological mapping, Oil exploration – salt domes, structural traps, mineral exploration – sulphide ores, ferrous and non-ferrous ores, diamonds, placer deposits, groundwater and Engineering problems.

- Books:**
1. The Earth and its gravity field, A.A.Heiskanen and F.A Vening
 2. Gravity and magnetics in oil prospecting, L.L.Nettleton
 3. Gravity and magnetic methods, Rao, B.S.R and Murthy, I.V.R
 4. Gravity and magnetic Interpretation in Exploration Geophysics, I.V.Radhakrishna Murthy
 5. Marine Gravity, Peter Denelinagar
 6. Applied Geophysics, W.W.Telford et. al
 7. Introduction to Geophysical prospecting, M.B.Dobrin
 8. Interpretation theory in Applied Geophysics, F.S.Grant and West.

GS 302: ELECTRICAL METHODS

- Unit I Principle of electrical methods of prospecting – Electrical fields in Geophysics- current and potential in the Earth- equipotential lines of force –due to single point and dipole sources and line of electrodes. Distribution of current across layers of contrasting resistivities. Electrical properties of rocks and minerals – Laboratory measurements of electrical properties of rocks.
- Unit II Electric conduction in rocks and minerals – electronic- ionic and dielectric. Electrochemical properties. Factors affecting the resistivity of rocks. Archie's Law. Isotropy and Anisotropy. Principle of equivalence and suppression. Dar Zarrouk parameters – longitudinal conductance and transverse resistance.
- Unit III Self Potentials: origin- classification – electrochemical and electro-kinetic potentials – behavior. Measurement of self potentials- equipment- field techniques. SP anomalies over different geometrical models – sphere, fault, dyke and sheet etc.. - Interpretation of SP anomalies
- Unit IV Potential due to a point source- dipole and line sources in homogeneous earth. Effect of inhomogeneous ground. Concept of apparent resistivity – apparent resistivity for multi-layered earth. Principle of reciprocity. Reflection coefficient
- Unit V Different types of electrode arrays: Wenner- Schlumberger - Dipole- Dipole- Half Schlumberger-, Central Gradient etc.. Geometric factors and theoretical derivations for apparent resistivity for different electrode configurations.

- Books:**
1. Applied Geophysics, W.M. Telford et.al.
 2. Electrical Methods in geophysical prospecting by George V.Keller
 3. D.C Geo electric sounding by P.K.Bhattacharya and H.P.Patra
 4. Geo sounding Principles, Vol 1 by O.Koefoed

GS 303: SEISMIC METHODS – 1

- Unit –I Principles of elasticity: Normal strains, shearing strains, Hook's law, Elastic moduli, wave equations, Huygen's & Fermat's Principles, Zeoppritz equations, refraction, reflection, critical refraction, diffraction, attenuation & absorption of seismic waves, acoustic impedance, surface waves, dispersion multiples, reflection and transmission coefficients.
- Unit- II Elastic wave velocities of rocks: laboratory and field measurements, dynamic moduli, P and S-wave velocities, anisotropy, attenuation, factors affecting velocity, different types of velocities, geometry of ray paths, refraction and reflection, horizontal layers and dipping layers, NMO and dip move out, discrete and continuous velocity changes, velocity inversion, low velocity layer, blind zone, hidden layer.
- Unit-III Electromagnetic geophone and its performance, damping coefficient, hydrophones, detector arrays, array response, uniform arrays, amplitude weighted arrays, distance tapered arrays, streamer, analog data acquisition, amplifiers, filters, gain control and recording types. Seismic energy sources for land and marine surveys. Dynamite thumper, dinosies, vibrosies, land air gun, pinger, boomer, sparker, airgun, water gun, vaporchoc etc. Controlled explosions, shot control, source arrays, energy content, frequency, pulse length and resolution, penetration, signatures of energy sources.
- Unit-IV Digital data acquisition, digital field system, signal flow and recording. Constituent units and modules. Telemetry systems, wireline and radio telemetry, telemetry system configuration and specifications, dynamic range of signals noise: shot generation, ambient and electrical noises, their nature and attenuation requirements. Noise survey, noise analysis, fold back experiment, optimization of parameters.
- Unit – V Single channel and multi channel surveys, field layouts and shooting procedures for land and marine 2D surveys, split spread and end-on spreads, CDP procedures for land and marine surveys, stacking chart. 3D surveys, 3D layouts, swath, brick, odds & evens, zig zag, button patch, full range 3D, loop survey. Marine 3D shooting: two streamer system, alternate shooting, two boat operation, circles shooting, 3D bottom cable survey, quad quad 3D, multiple streamers, static binning and dynamite binning. Refraction surveys: Field procedures, fan shooting, broad side shooting, inline profiling, long refraction profiles, reversed and unreversed profiles, marine refraction surveys, sonobuoy surveys. (VSP, shear wave data acquisition and other special surveys procedures are included in paper II along with processing and interpretation of seismic data)

Books:

1. Introduction to geophysical prospecting, M.B.Dobrin.
2. Applied Geophysics, W.M.Telford et. al.
3. Exploration seismology, Sheriff. R.E.
4. Seismic exploration fundamentals, J.A.Coffeen.
5. A hand book for seismic data acquisition, Brain J Evans
6. Designing seismic surveys in two and three dimensions, Dale G Stone

GS - 304 PRINCIPLES OF WELL LOGGING

Unit 1: Basic concepts and objectives of well logging. Reservoir rocks and its petro physical properties. Porosity & Permeability: classification of porosity and Permeability; factors governing magnitude of Porosity & Permeability; permeability-porosity relationship. Formation resistivity factor (FR); correlations between FR and tortuosity; correlations between FR and cementation; correlations between FR and water saturation; correlations between FR and permeability. Need of drilling fluids, and its properties. Bore hole environment, invasion effect and invasion profile. Classification of well logging tools, well logging unit and logging setup. Reservoir geometry, temperature and pressure. Log header, depth scale. depth of investigation and vertical resolution

Unit II: Electrical logging:

SP Log-Origin and occurrence of Self Potential. Factors affecting shape amplitude of SP curve, PSP & SSP, Determination of salinity of formation water from Sp log. **Concept of resistivity in well logging;** factors affecting the resistivity of electrolyte bearing rocks. **Unfocused Resistivity Devices:** single-electrode systems and its limitations; normal and lateral resistivity tools and their limitations; factors affecting normal and lateral resistivity measurements; microresistivity measurements- tools, applications and limitations

Focused Resistivity Devices: principle of measurement, tools and factors influencing resistivity measurements.

Induction Resistivity Measurements: principle, two-coil induction tool and its geometric factor, focusing of two coil sonde, skin effect, factors affecting induction resistivity measurements,

Unit-III: Radioactive & Miscellaneous logs.

Sources of natural radioactivity and gamma radiation; geochemical behavior of potassium, thorium and uranium; radioactivity of shales and clays; simple and spectral gamma ray tool including radiation detectors; calibration of simple and spectral gamma ray tool; factors affecting gamma ray log response; depth of investigation and unwanted borehole effects in gamma log; qualitative and quantitative uses of simple and spectral gamma ray log, How SP log is different from gamma ray log

Miscellaneous tools: Dipmeter, caliper, side wall coring tools, Casing Collar Locator.

UNIT IV: Porosity Logs

Acoustic Log: Principles; factors affecting acoustic wave velocity; acoustic logging tools- single and double receiver type tools; borehole compensated systems; cycle skipping in acoustic log; bed thickness effect on acoustic log; depth of investigation; porosity evaluation of consolidated and uncompacted sandstones (clean as well as shaly) and carbonates rocks; overpressure identification; seismic applications.

Density Log: Interaction of gamma rays with matter; principle of density log; energy requirements of gamma ray sources for density log; measurement tools- single and double detector type; log characteristics- depth of investigation and bed resolution; porosity measurements and other formation evaluations; factors affecting porosity measurements; litho-density log- principles and formation evaluation.

Neutron Log: Interaction of neutrons with matter, neutron sources and neutron detectors, neutron moderation and principle of neutron log, neutron logging tools- single spacing type, sidewall-neutron porosity probes, borehole compensated systems; corrections in porosity measurements due to the presence of shale, rock type, borehole, and cased hole; depth of investigation and source-detector spacing; calibration of logging systems.

Unit-V: Formation_Evaluation: Log Quality Control, Identification of porous and

permeable formations. Effect of shaliness on porosity. Determination of Water saturation in shaly formation. Cross plots, M-N plots. Determination of water saturation (SW) of clean formations using (i) Archie's cross- plot, (ii) Hingle plot (iii) Formation factor comparison method (iii) resistivity ratio methods (iv) movable hydrocarbon method: Quick look interpretation and detailed interpretation of Clean sands and Shaly sands, Identification of Hydrocarbon zones.

Hydrocarbon zones, Mineral Zones, water Zones and Coals.

Books:

1. Formation Evaluation, E J Lynch
2. Induction Logging, Plusynin.
3. Log Interpretation Principles and Charts, Schlumberger
4. Schlumberger Documents,
5. Development and Exploitation of Oils and Gas Fields, Murovyer and Andiasevrentnal
6. Handbook of Well Log Analysis, S J Peterson.

GS 401: SIGNAL PROCESSING AND INVERSION THEORY

- Unit I** Introduction, Definition of signal and noise, various signal classes such as continuous, piece wise continuous, absolute integrable, singularity, unit impulse, unit step, etc. Fourier series and Fourier Transforms: Time and frequency domain, relations between various operations in both the domain, Fourier Transform and its properties, Fourier Transforms of some important functions: Rectangular, exponential functions, singularity functions and periodic functions.
- Unit II** Time-series analysis: Discrete time signals, Correlation and convolution functions, impulse response and Transfer function spectrum of observational data: Discrete Fourier Transform (DFT), FFT, Z-Transforms, Delay properties of wavelets.
- Unit III** Band limited signals: Properties, Sampling Theorem, Nyquist frequency, Aliasing, Sampling of band and time limited signals; Effect of sampling on spectrum and vice-versa; reproduction of continuous function from sampled data. Importance and effects of Windowing, Gibbs phenomenon, spectral leakage, various types of windows; power spectrum; Estimation of power spectrum, Wiener Khinchin theorem, use of various windows in power spectrum computation, spectrum computation via Auto-correlation and Periodogram.
- Unit IV** Digital filtering: Design of digital filters, amplitude and phase response of various filters; one-sided and two sided filters, low-pass, high pass and band-pass, optimum filters, Butter worth filter, Recursive and non-recursive filters, optimal and Weiner filters, Deconvolution and predictive deconvolution. Numerical solution of differential equations – Introduction, Solution by Taylor series, Picard’s method of successive approximation, Eulers method, Runga-Kutta method. Finite element methods: Basic concept of the finite element method. Boundary and Initial value problem.
- Unit-V** Inversion Theory: Introduction, Fundamentals of Inversion, Linear Inversion, Non-Linear Inversion, Incorporating prior information, Parametric Inversion. One dimensional minimization methods – Introduction, Fibonacci method. Introduction to unconstrained optimization techniques. Introduction of Steepest descent method, gradient techniques and Marquardt’s method. Assessing the uncertainty in inverted models.

Books:

1. Spectral analysis in Geophysics, Markus Bath
2. Theory and application of digital signal processing, Rabiner, L.R and Gold, B.
3. Digital signal processing and time series analysis, Enders A. Robinson
4. Statistical theory of communication, Y.W. Lee
5. Analysis of Geophysical Potential Fields, P.S. Naidu & M.P. Mathew
6. Seismic Filtering, Nathan Rothenburg, SEG publication
7. Time sequence analysis in Geophysics, E.R. Kanasevich
8. Signal Analysis, B.P. Lathy
9. Inverse problem theory, Tarantola, A., 1987
10. Solutions of ill-posed problems, Tikhonov, A.V, and Arsenin, V.Y, 1977
11. Computational methods for Inverse problems, Vogel, C.R, 2001

GS 402: ELECTROMAGNETIC METHODS

- UNIT I **Basics:** Electromagnetic Induction, Primary-Secondary field relations, Vector Diagram- Real and Imaginary components resolving; Inductive and resistive limits, Response function, Elliptic polarization, Maxwell's equations, Boundary conditions, Wave equation, Quasi static condition, Solution of wave equation, Plane wave characteristics, propagation of plane waves in conducting media, Wave number, Impedance, Skin depth versus effective depth, factors controlling depth penetration.
- Unit II **Classification of E.M. methods:** Sources used, continuous wave and pulse excitation principles, Measured components. Brief principles of solving electrodynamic problems including scale modeling. Field of large loop, magnetic dipole and electric dipole in air – frequency and Time domain approaches
- Unit III Field of magnetic dipole and electric dipole (both in transient and frequency domains) in homogeneous, isotropic space. Response of stratified medium to the above sources. Frequency and transient response of local conductors in homogeneous field –Sphere and Cylinder. Effect of frequency and magnetic permeability on the secondary fields – Sphere as an example, Generalized induction parameter. Effect of overburden and Host rock on E.M. response.
- Unit IV Methods using artificial fields: Surface low frequency methods: Principles, field procedures and various corrections, quantitative interpretation in Turam, Tilt angle and Slingram methods, Operation at low induction numbers - terrain conductivity measurements. Surface transient methods: Principles, Comparison with harmonic methods, Description of different current functions, various T-R configurations, General field procedures, Interpretation of surface transient method data.
- Unit V Radio wave methods: Principles, Theory and description, different equipment of VLF EM method. Interpretation of VLF EMR data - Applications. Brief principles of Ground Penetrating Radar and its applications in shallow depth investigations. Principles of EM soundings, Field procedures, Geometric versus parametric sounding, data preparation, interpretation and applications.

Books:

1. Interpretation theory in Applied Geophysics by Grant and West
2. Applied Geophysics by Telford, et. al., revised edition
3. Mining Geophysics, Vols. 1 & 2 – SEG publications
4. Electrical methods of Geophysical Prospecting by Keller and Frischknecht
5. Geosounding Principles Vol. II by Patra and Mallick
6. Mining Geophysics by Parasnis
7. Introduction to Geophysical Exploration, by Kearey and Brooks
8. EM methods in Applied Geophysics, Vols.I &II by Nabighian, M.N ed, SEG Publications
9. Deep Electromagnetic Exploration, K.K.Roy, S.K.Verma and K.Mallick (eds), Narosa Publishing House, 1999.
10. The Geoelectrical methods in Geophysical Exploration by M.S.Zhdanov and G.V.Keller, Elsevier, 1990

GS-403: SEISMIC METHODS – II

- Unit –I Reduction of refraction data, interpretation of refraction data, analysis of refraction records, interpretation of reversed and unreversed profiles, delay time methods, forward modeling, masked layers and hidden layers, reduction and interpretation of sonobuoy data, crustal seismology, engineering surveys, exploration for ground water, application in mining industry.
- Unit- II Reflection data processing, static and dynamic corrections, velocity determination. Preparation of seismic sections migration, analysis of analog records, automatic processing of digital seismic data, demultiplexing, TAR, velocity analysis, velocity spectra and velocity scan, automatic statics, picking, stacking, spiking deconvolution, dereverberation, whitening, time variant frequency filtering, apparent velocity filtering. AVO analysis, different methods of migration, automatic migration, wavelet processing.
- Unit-III Seismic section plotting, display types, picking of events, marking-isochron & isopach maps, geological interpretation, application of reflection method exploration for oil and gas, groundwater, coal, mineral deposits, gas hydrates, etc., engineering applications, crustal studies, structural and stratigraphic traps, identification of geological structures like anticlines, faults, salt domes etc; fit falls in interpretation.
- Unit-IV hydrocarbon indicators, bright spot, seismic attributes, AVO analysis, vertical seismic profiling, equipment, configurations like deviated well, walk away, offset VSP etc., applications, 3D data processing and interpretation, visualization in an animated interactive environment.
- Unit – V Seismic stratigraphy, geological sea level change model, depositional patterns, seismic sequence, seismic facies, reflection character, synthetic seismogram, modeling concepts, high resolution seismic surveys, shallow engineering surveys and suitable energy sources, 4C, 4D recording, seismic tomography, reservoir applications of petrophysics concepts, generation and recording of shear waves, energy sources, geophones, recording, processing, section plotting, interpretation V_p/V_s as lithology indicator, hydrocarbons, engineering applications.

Books:

1. Introduction to geophysical prospecting, M.B.Dobrin.
2. Applied Geophysics, W.M.Telford et. al.
3. Exploration seismology, Sheriff. R.E.
4. An introduction to seismic interpretation, R. Mcquillin et.al.
5. Seismic stratigraphy-application to hydrocarbon exploration Ed. By Charles Payton.
6. Shear wave exploration, SH Danbom and SN Domenico
7. Multicomponent seismology in petroleum exploration, RH Tathamz and MD McCormack
8. Fundamentals of seismic tomography, Lo and Inderweisen
9. Reservoir studies, SEG publication.

GS – 404 WELL LOGGING AND RESERVOIR ANALYSIS

Unit -I: Reservoir Thickness, effective, Pay and Net thicknesses, Flow in Vertical Pipes, Flow Types, Reynolds Number, Perforations, Water Holdup, Water Cut, Slippage Velocity, Cased hole Production Log Units & different Tools Logging While Drilling (LWD).

Unit -II: Production Logs: Temperature Log, Flow meters, different types of Flow meters, Gradiomanometer, Radioactive tracer logs. Well problems- their diagnosis with different Production Logs, Injection Wells, Interpretation of Flow meter & Temperature logs in Injection/ Production wells.

Unit -III: NMR technique for permeability, bound and Free water estimations-wire line sampling –Fluid sampling & Pressure measurements. Formation tester- Repeat Formation Tester, Formation Micro Imager.

Unit -IV: Advanced logging Tools- Chlorine Log, Carbon/Oxygen Logging, Thermal Decay Time Log-Electromagnetic Casing Inspection Tools- Noise Logging.

Unit -V: Acoustic Cement Evaluation-Cement Bond Log, Log Presentation-Factors Affecting Log Presentation-Borehole Compensated CBL-VBL, Brief outline of production logging in Configuration of a Horizontal Well, Production Logging Tool Response in Horizontal Flows.

Books :

1. Formation Evaluation- E J Lynch
2. Induction Logging- Plusynin.
3. Log Interpretation Principles and Charts - Schlumberger
4. Schlumberger Documents,
5. Development and Exploitation of Oils and Gas Fields - Murovyer and Andiasevrentnal
6. Handbook of Well Log Analysis - S J Peterson.

GS 501 REMOTE SENSING & GIS **(Common paper for all specializations)**

- UNIT-1 Fundamentals of Remote Sensing: Introduction: basic principles of remote sensing; electromagnetic spectrum; Planck's law and Wien's displacement law; concept of incoming short wave and outgoing long wave radiation: passive and active remote sensing, interaction of electromagnetic radiation with matter; interaction of electromagnetic radiation with atmosphere; selective and non-selective scattering; impact of scattering on remotely sensed data; atmospheric windows and absorption bands
- UNIT-2 Spectral reflectance properties and Sensors: interaction of electromagnetic radiation with solids and liquids of the earth's surface; spectral reflectance curves of water, snow, clouds, and vegetation. Soils/rocks/minerals. Sensors: imaging and non-imaging sensors: radiometers, spectrometers. Spectroradiometers; Scanner dependent systems: line scan systems, array scanning systems, multispectral scanner systems: whiskbroom and pushbroom imaging systems; circular/conical/side scanning systems: sensor characteristics - spatial resolution, spectral resolution, radiometric resolution and temporal resolution.
- UNIT -3 Aerial photography: various types of aerial cameras and black and white films; scale, brightness, contrast of photograph; resolution of photograph - resolving power of film and camera lens; vertical and oblique aerial photographs; methods of aerial photographic surveys; parallax/relief displacement, stereophotography, mirror and pocket stereoscopes, Photomosaic, low and high sun elevation angle photography. Color theory - primary and secondary colors; additive and subtractive color mixtures to generate colors, color code, working principle of normal and infrared color films and photographs; color composites - true, standard false color and false color composites; application of normal and infra red photographs.
- UNIT - 4 Satellite remote sensing: Various platforms used for remote sensing data acquisition; orbits of satellites; geo-synchronous and sun-synchronous orbits; OPTICAL REMOTE SENSING SATELLITES: environmental meteorological satellites (past and present) and their sensors - GOES, Meteosat, INSAT, GMS, NOAA etc.; earth resources observation satellites (past, present and future) and their sensors - NIMB US/coastal zone color scanner, Landsat, Spot, Mos, IRS-1a, 1b, 1c, 1d, p2, p3, p4, p5, p6 etc. Indian remote sensing activity; future remote sensing missions of ISRO for earth observation.
- UNIT-5 Thermal infrared remote sensing: Thermal processes and properties, radiant flux, heat transfer, atmospheric transmission, thermal properties of materials, thermal infrared signatures of various rocks and minerals, influence of water and vegetation on thermal inertia; thermal infrared sensors like infrared radiometers, working principle of thermal infrared scanner; TIRS etc.; satellites and sensors acquired and acquiring data under thermal infrared region - HCMM, NOAA-AVHRR, EOS-TERRA, EOS-AQUA, Geostationary satellite sensors etc.; characteristics of thermal infrared images, relative comparison of night and daytime thermal infrared imagery; advantage of thermal infrared remote sensing
- UNIT - 5 Geographical information systems (GIS): Introduction: functions of GIS, spatial data bases - position, attributes; data base structures; data base management; geographic data types - vector and raster; introduction to coordinate system and map projections; application of GIS in Hydrology and other earth sciences.

Books :

1. Remote Sensing: Principles and Interpretation, Floyd F. Sabins, IR.. W.H.. Freeman & Co., San Francisco, 426 p
2. Introduction to the Physics and Techniques of Remote Sensing, Charles Elachi: John Wiley & Sons p. 413
3. Information Booklets from various satellite agencies
4. Manual of Remote Sensing, Vol. I & Vol. II, Ed, American Society for photogrammetry and Remote Sensing

GS 502 : MARINE GEOPHYSICS

(Common paper for all specializations)

Unit I: Physiography and divisions of the sea floor, continental shelves, slopes and aprons, submarine canyons and deep sea channels, sea mounts and abyssal plains, turbidity currents and submarine sedimentation, the mid oceanic ridge systems and its structure, aseismic ridges, various types of ridges in the Indian ocean region, the continental fracture system and island arcs, occurrence of offshore mineral deposits and hydrocarbons, hotspots, mineral resources of the sea: surficial deposits of the shelf and deep sea, heavy mineral placers, calcareous shells, pearl oysters, phosphorites, glauconite, barium sulfate concretions, sand and gravel, extensions of ore deposits, hydrocarbon potential of the shelf and offshore sedimentary basins.

Unit II: Geophysical instrumentation and surveys: Adaptation of geophysical instruments for marine surveys, Measurements at the sea surface and under water, geophysical equipment currently in use and board research vessels, complement of equipment on board the survey ship and layout of equipment, towing logistics, survey procedures and planning of survey lines, marine magnetometers, marine gravimeters, surface and under water gravimeters, Graf Askanián, Lacoste Romberg and vibrating string gravimeters, calculation of gravity anomalies.

Unit III: Map projections: Different kinds of map projections, Position fixing at sea: long range and short range systems, integrated satellite navigation, Global Positioning System (GPS), Bathymetry: echosounding, bathymetric charts, bathymetry as an adjunct to geophysical surveys, submersibles, seabed mapping by side scan sonar, multibeam, lidar and other surveys, seabed sampling, dredging and coring, marine geophysical surveys for seabed resources, site selection for production platforms, tunneling, waste disposal etc.

Unit IV: Oceanic magnetic anomalies, sea floor spreading, Vine-Mathews hypothesis, geomagnetic time scale and dating the ocean floor, linear magnetic anomalies. Heat flow: Earth's internal sources of heat, transfer of heat within the earth, measurements at the ocean bottom, heat flow probes and measurements, factors affecting the Heat flow measurements in sea, oceanic heat flow, ocean ridges and ocean basins, marginal basins, rift valleys.

Unit V: Objectives of marine geophysical surveys, marine geophysical surveys for sea bed resources, engineering investigations, deep sea geological mapping, delineation of continent-oceanic boundary, geological mapping in the coastal zone. Results of some rare studies. Geophysical anomalies of trenches, active and passive margins, ridges, island arcs, Large scale and small-scale structural features of the oceanic crust from seismic surveys (velocity structure)

Books:

1. Marine geophysics, EJW Jones
2. Physics and geology, Jacobs, Russel and Wilson
3. Introduction to geophysical prospecting, MB Dobrin
4. Applied geophysics, WM Telford, et. Al.
5. Geodynamic, Turcuttoe
6. The interior of the Earth, MHP Bott.

GS-503: PETROLEUM GEOLOGY & GEOPHYSICS

(Special paper for M Sc (Tech) Geophysics with petroleum & mineral exploration)

- Unit I** Petroleum – occurrence – distribution- chemical and physical properties – Origin- various theories, source rock, organic matter – Maturation into petroleum – P&T conditions, Migration – primary and secondary.
- Unit II Reservoir – rocks – properties – Fluids, water – oil- Natural gas- properties, Traps- structural – stratigraphic – combination, seals, sedimentary basins – cratonic – convergent and divergent margin basins – classification, Category-1 basins of India
- Unit III Gravity and Magnetic methods in petroleum exploration – surveys – Land and ocean areas – differences – data processing operations, Gravity anomalies – salt domes – stratigraphic traps. Magnetic methods – basement mapping, computer oriented methods.
- Unit IV Seismic data processing – outlines, preparation of seismic section, Reflection character- structure, pitfalls – migration 2D & 3D significance – velocity pull up, structure identification.
- Unit V Seismic stratigraphy – Unconformities – seismic sequences – reflection pattern – depositional environment – basin history – construction, Modelling concept – Reservoir parameters – forward and inverse, direct detection – Bright spots – flat spots Gas hydrates, Coal bed methane.

Books:

1. Ravi Bastia: Geologic settings and petroleum system of India-East coast off shore basins- Concepts and application.
2. A.I.Levorson: Geology of Petroleum
3. R.C.Selly & David C.Morri:-Basic concepts of petroleum Geology
4. Jutshi P.L and Pawar M.S:Geology of Petroleum basins of India
5. Weimer P & R.M.Slatt: Introduction to petroleum Geology of deep water settings, AAPG studies in Geology series
6. Michael D.Max, Arthur H.Johnson & William P.Dillon: Economic geology of natural gas hydrates.

GS 504: MINING GROUND WATER AND ENVIRONMENTAL GEOPHYSICS

(Special paper for M Sc (Tech) Geophysics with petroleum & mineral exploration Specialization)

- Unit I** Crustal layers-upper and lower, Different elements in the crust, Precious and other useful substances in the upper crustal layers, Metallogenic provinces and periods. Classification of mineral deposits – Metallic and non metallic, Classification of metallic deposits-Ferrous and non ferrous, Base and noble metals, Sulphides, Oxides, Silicates and Carbonates, Processes of formation of mineral deposits – Igneous activity, Sedimentation, Metamorphism, Weathering and Erosion, Hydrothermal processes.
- Unit II Mineral deposits of India -Base metals and Ferrous metals, Geological mapping-Geophysical methods, Sulphide ores-Massive and disseminated ores-Prospecting strategies-examples, Iron ores-Strong and weak magnetic iron ores, genesis-prospecting.
- Unit III Manganese, Chromium, Placers-Prospecting strategies, Diamonds, Genesis of coal deposits of India - Geophysical prospecting, Logging in mineral exploration, Synergic interpretation.
- Unit IV Ground water occurrence – Igneous-Metamorphic and sedimentary rocks, Types of aquifers and their hydrological significance, Vertical distribution of water, surface investigations of groundwater-Geological method-Remote sensing-Hydrobotanical, Review of electrical resistivity and seismic refraction methods – Groundwater exploration, Buried channels, Sea water intrusion.
- Unit V Geophysics and earth's environment, Environmental problems amenable to solution by geophysical means, Engineering Geophysical problems, Survey procedures-modifications only for Environmental and Engineering Geophysics-Gravity, Magnetic, Seismic, Electrical and E.M, Radioactive and Geothermal surveys, Examples.

Books:

1. Mining Geophysics, SEG, Volume-I
2. Ground water Hydrology, D.K.Todd
3. Geophysical practice in mineral exploration and Mapping, T.S. Rama Krishna

GS-505: NATURAL HAZARDS, COASTAL ZONE MANAGEMENT AND OCEAN LOGISTICS

(Special paper for M Sc (Tech) Geophysics with Marine Geophysics Specialization)

Unit-I: Cyclones, storm surges and Tsunami, Concept of Tsunami; Relation between sub-sea earthquakes and onset of Tsunami; Impact of Coastal morphology on Tsunami surge. Tsunami Surge Models.

Unit-II: Land-Ocean Tectonics, Coastal seismicity, neotectonics, geophysical methods on Land-Ocean Tectonics, some case studies, Seismo-tectonics of Indian sub-continent, High resolution seismics to delineate Geohazards like Sediment lumps, Buried channels, Palaeo-reefs etc.

Unit-III: Threat to Coastal Zone due to industrialization, CRZ, its concept, Integrated Coastal Zone Development. Environmental Impact assessment for sustainable Coastal Zone Development. Public awareness on sustainable Coastal Zone Development.

Unit-IV: Geophysical studies in EIA, Seabed studies for recommendation of marine outfalls-Case-Studies.

Unit-V: Law of Seas, Legal Continental Shelf (LCS), Geophysical studies for identifying LCS. Other International Conventions for exploration of deep-sea-resources.

Books:

4. Indian Ocean Tsunami by Tad Murthy et al
5. Tsunami by Walter. C. Dudley, Min Lee, 1998 Nature, 362 pages (Google Books Roul)
6. Tropical Cyclone: The Storm Surge: www.britannica.com
7. Storm Surges: Our ocean planet by Robert Stewart Oceanography in the 21st century – an online text book www.oceanworld.tamu.edu
8. Seismicity, neotectonics and recent dynamics by Scheidegger, et al 1980.
9. Aylesburn, 2nd Ed 32 Page
10. Geodetic contribution to the study of seismo tectonics in India by R. Bilhani 2000 www.ias.ac.in/curr.sci.
11. CRZ in India www.envfor.nic.in/legsi.htm
12. M.S. Swaminathan Report on CRZ (website)
13. Law of Seas: UN Convention on the Law of the Sea www.en.wikipedia.org/wiki and www.guestia.com/library
14. The continental shelf and the exclusive economic zone by Donat Pharand – 1993-404 page.
15. The legal continental shelf www.springer.com
16. International Environmental Law and Economic by P.K. Rao, 2002. books.google.co.in

GS 507 GEOHYDROLOGY & ENVIRONMENTAL HYDROLOGY **(Special paper for M Sc (Tech) Geophysics with Hydrology Specialization)**

Unit-1

Geohydrology, Hydrologic cycle, Occurrence of Groundwater: Aquifer, Aquiclude, Aquifuge and Aquitard, Porosity, Effective porosity, Vertical distribution of Groundwater; Zone of aeration, zone of saturation, Division of subsurface water. Specific retention, specific yield, Geologic formations as aquifers, Types of aquifers, Storage coefficient, Groundwater Basins and springs. Water movement in saturated soils, Darcy's law. Permeability, Intrinsic permeability. Hydraulic conductivity, Transmissivity, Determination of Hydraulic conductivity.

Unit-II

Concept of Infiltration, Double ring infiltrometers, Concept of recharge. Groundwater fluctuations: Secular, Seasonal and Short-term fluctuations, Evapotranspiration, Meteorological phenomena, tides, Urbanization, Earthquakes and External load, Land subsidence, Concept and Techniques of Artificial Recharge of Groundwater: Salt water intrusion in coastal aquifers. Ghyben Herzberg Concept.

Unit-III

Pumping tests: Conducting pumping tests, Theis, Jacob, Chow and Papadopulos methods of determining aquifer parameters, recovery test: Determination of transmissivity, storage coefficient, specific yield and specific capacity, recovery test. Types of water wells, methods of drilling wells, well design, well completion and development, pumping equipment.

Unit-IV

Physical and chemical properties of water, chemical dissolved constituents – major and minor and traces, water sampling techniques and analysis for chemical constituents. Interpretation of chemical data, representation of data : Gibb's diagram, Piper, Wilcox, SAR and Durov plots.

Unit-V

Groundwater pollution, point source and non point source, environmental impact of municipal solid waste dumps, hospital wastes, excess pumping in coastal areas, mining areas, mineral and hydrocarbons Aquaculture, subterranean water of oil field, oil field brines. Identification of groundwater contamination, environmental isotopes, tracers, and their application. Control measures of contaminant into groundwater

Books:

1. Hand book of Applied Hydrology, Ven Te Chow
2. Groundwater Hydrology , D.K.Todd
3. Facets of Hydrology , John C Rodda
4. Groundwater ,H.M.Raghunath
5. Groundwater Manual , U.S.Department of the Interior
6. Hydrogeology , Davis & De weist
7. Geohydrology , De weist
8. Applied Hydrology, K.N.Mutreja
9. A textbook of Hydrology, prof. PJayaramireddy
10. Applied Hydrology , R.K.Linsley, M.A.Kohler & Paulhus
11. Study and Interpretation of the chemical properties of Natural waters – an USGS publication – JD Hem
12. The properties of groundwater – George Mathess
13. Physical and Chemical Hydrology – Patrick A Domenico and Franklin W. Schwartz.
14. Applied Hydrology – C.W. Fetter.
15. Concepts of Ecology – E.J. Kormondy
16. Protection of public water supplies from groundwater contamination – U.S. Environmental protection Agency Publication 1985.
17. Groundwater Hydrology – H. Bower

GS 508: GROUND WATER DYNAMICS & HYDROLOGIC MODELLING
(Special paper for M Sc (Tech) Geophysics with Hydrology Specialization)

Unit – I : Groundwater movement; Basic flow equations. Steady flow, unsteady flow, and the analysis- Steady and unsteady radial flow for confined and unconfined aquifers, Well in uniform flow. Flow in leaky aquifers. Flow nets, refraction at permeable boundaries.

Unit-II : Multiple well system, partially penetrating wells, well losses.
Well flow near aquifer boundaries: Image well theory, recharge boundary and barrier boundary and other boundaries.

Unit-III: Different Types of Hydrological models: Introduction to Physical models, Continuous and Discrete models
Physical models: Sand models, Tank model to simulate network of reservoirs; Laboratory tank models used in Electrical resistivity modelling, Horizontal and Vertical HELESHAW (Viscous fluid) model.
Continuous systems: Conductive liquid and solid analogue models
Discrete systems: Electrical analog models, Resistance-Capacitance Networks, Resistance Networks. Application of analog models. Comparison of Analogue and application of Digital Models.

Unit IV: Mathematical models- 3D Groundwater flow equations for confined and unconfined aquifers- Finite difference modeling, Iterative alternative direction implicit method. Finite element method-relative advantages and disadvantages of finite difference and finite element methods. Groundwater contamination modeling- Solute transport models.

Unit V: Watershed concept, concepts of integrated study of watershed management. Rain water structures, design and economic aspects.

Soil and water conservation, contour demarcation: Contour Demarcation, Bunding, Hedging, Terracing, Gully control, Check dams, Mini percolation tanks, Percolation Sunken gully pits, Boundary Bunds, Contour Bunds, Watersheds and its Impact on Environment, Socioeconomic, Water quality, Remedial measures in adverse conditions.

Books:

1. Hand Book of Applied Hydrology, Ven Te Chow (ed.)
2. Groundwater, D.K.Todd
3. Groundwater resource evaluation, W.C.Walton
4. Applied Hydrology, K.N.Mutreja
5. Physical principles of water percolation and seepage, J. Bear et al
6. Advances in Hydro-sciences, Ven Te Chow
7. Numerical methods in subsurface Hydrology, Irwin Remson et al
8. Computer simulation Techniques in Hydrology, George Fleming
9. Applied Hydrogeology, E.W.Fetter
10. Watershed Management, J.V.S.Murthy
11. Facets of Hydrology, John C Rodda
12. Watershed Development, V.V.J.Sarma, C. Subba Rao and N.V.B.S.S.Prasad
13. Watersheds Comprehensive Development, K.V.Seshagiri Rao
14. Hydrology & Watershed Management, B. Venkateswara Rao