M.Sc. MARINE GEOPHYSICS:

Semester – I			Semester - II		
Theory			**Theory**		
Code	Subject	Marks	Code	Subject	Marks
MGS 101	Geology – I	85+15*	MGS 201	Geology – II	85+15*
MGS 102	Signal Processing & Inversion Theory	85+15*	MGS 202	Mathematics	85+15*
MGS 103	Physics of the Earth	85+15*	MGS 203	Computer Programming	85+15*
MGS 104	Seismology	85+15*	MGS 204	Geomagnetism	85+15*
Practicals**			**Practicals**		
MGS 105	Geology – I	50	MGS 205	Geology – II	50
MGS 106	Seismology	50	MGS 206	Computer Programming	50
MGS 107	Viva-Voce	50	MGS 207	Viva-Voce	50
Total		550	Total		550

Semester – III			Semester - IV		
Theory			**Theory**		
Code	Subject	Marks	Code	Subject	Marks
MGS 301	Seismic Methods – I	85+15*	MGS 401	Seismic Methods – II	85+15*
MGS 302	Gravity Method	85+15*	MGS 402	Magnetic Method	85+15*
MGS 303	Principles of Well Logging	85+15*	MGS 403	Well Logging & Reservoir Analysis	85+15*
MGS 304	Marine Geophysics	85+15*	MGS 404	Geodynamics	85+15*
Practicals**			**Practicals**		
MGS 305	Seismic Methods – I	50	MGS 405	Seismic Methods – II	50
MGS 306	Gravity Method	50	MGS 406	Magnetic Method	50
MGS 307	Well Logging	50	MGS 407	Project Work	100
MGS 308	Marine Geophysics	50	MGS 408	Viva-Voce	100
MGS 309	Viva-Voce	50			
Total		650	Total		700
Grand Total					2450

Semester End Examination Marks: 85

* Mid Semester Examination Marks: 15

Theory and Practice Individual Paper Minimum Pass: 40%

Viva-Voce Pass : 50%

Theory, Practical and Viva-Voce Total Aggregate Pass : 50%

** I, & III Semester Practical Examinations will be conducted along with II & IV semester end practical examinations respectively.

M.Sc Marine Geophysics

MGS-101 GEOLOGY - I

UNIT I: Basic assumptions in Geology, relation of geology with sciences-branches of geology-figure and dimensions of earth, structure, composition and origin of earth-Envelops of the earth-crust, mantle, core, External dynamic process- weathering, geological work of wind-weathering, erosion and denudation, cycle of erosion, transportation and deposition agents-loess, relief. Desert types.

UNIT II: Geological work of surface flowing water-streams, rivers, their development. River systems-meandering, oxbow lakes, flood plains, peneplains and deltas. Geological work of underground water-permeability of rocks, types of water in rocks-classification of underground water-springs. Minerals waters-carbonate, sulphide and radioactive waters. Karst-forms, landslides, lakes and swamps, estuaries. Internal dynamic process-tectonic dislocations, neotectonics, earthquakes. Magmatism-volcanoes. Geological work of the sea-marine basins-relief features of the world, ocean floor. Temperature, salinity of seawater. Destructive work of sea-near shore accumulation forms-sedimentation in various zones of sea. Distribution of marine sediments.

UNIT III: Fundamental concepts in geomorphology-geomorphic processes-distribution of landforms-drainage patterns -development. Morphometric analysis of drainage basins, water sheds. Elements of hill slopes-pediment, bazadas. Landforms in relation to rock types, paleochannels, buried channels. Soils types and their classification. Evolution of major geomorphic process in India. Marine geomorphic processes, coastal morphological processes. Field and laboratory map scales, topographic maps, thematic maps, topographic and geomorphic profiles.

UNIT IV: Structural, textural, and chemical classification and origin of igneous, metamorphic and sedimentary rocks- Petrogenisis, granitisation. Petrographic characters of pegmatites, kimberlites and gondites- Sedimentary structures- petrographic characters of conglomerate, sandstone, shale, limestones. Process of dolamitisation. Metamorphism-structural classification of shale, phyllite, schist, gneiss, marble quartzite and granulites.

UNIT V: Science of minerals, physical and optical properties of minerals. Classification, structure and chemistry of Feldspar, Mica, Pyroxenes, Amphiboles, Olivine, Quartz and Garnet groups. Clay minerals, genesis and chemistry of native elements. Elements of crystallography, crystallographic axes, symmetry form of crystals and classification of crystals.

Books:

l. 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

MGS 102: 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 Transfors: 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.

Unit-V Inversion Theory: Introduction, Fundamentals of Inversion, Linear Inversion, Non-Linear Inversion, Incorporating prior information, Parametric Inversion, 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.Kanasewich
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,

MGS 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: The atmosphere, composition - internal structure, prevailing and adiabatic lapse rates, instability of dry and moist air, geo potential, cloud classification, condensation nuclei, artificial precipitation, fundamental forces in the atmosphere, coriolis force and the geo strophic winds, monsoon systems, cyclones, anticyclones and tornadoes, air masses and fronts, jet streams, climate and climatic changes, ozone and other trace gases.

Unit V: Hydrology - definition, hydrologic cycle, vertical distribution of groundwater types of aquifers, Darcy's law, porosity, permeability - laboratory measurement, well hydraulics - steady and unidirectional flow, quality of groundwater, concepts of water balance, sea water intrusion in coastal aquifers.

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

MGS-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. Modem 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 Richrds. P.G

MGS-201 GEOLOGY - II

UNIT I: Objectives of structural geology-composition and resolution of forces-stress, strain. Description of folds. Classification, mechanics and causes of folding. Foliation and lineation. Classification of faults, brittle and ductile structures, shearing and shear zones. Classification of unconformities. Map patterns and their uses in determination of large scale structures. Tectonic evolution of Dharwars, Eastern Ghats, Aravalis, Singhbhum and Cuddapahs. Evolution of Himalayas and tectonics. Outlines of geological mapping.

UNIT II: Earth and stratified rocks-importance of stratigraphy-geological cycle and time scale. Stratigraphic nomenclature and classification. Sargur, Dharwar, Singhbhum super groups, Aravalis and Eastern Ghat Mobile Belts, Cuddapahs, Vindyan and Kurnool systems, Deccan basalts, Cretaceous formations, and quaternary formations- boundary problems in stratigraphy.

UNIT III: Geochemical cycle, geochemical exploration methods, classification of elements. Analytical techniques for geochemical analysis. Outlines of standards preparation. Instruments and their exposure. Elements of ore petrology, characteristic features and genesis of ferrous and non-ferrous ore deposits of India. Mettalogeny, origin, migration and entrapment of petroleum deposits. Properties of source and reservoir rocks. Petroliferous basins of India- an outline. Classification of coal, ranking, and grading of coal deposits of India.

UNIT IV: Physiography and divisions of seas and world oceans. Properties of sea water-salinity, temperature, density. Littoral and sublittoral zones. Continental shelves, slopes, deep sea, aprons, seamounts and guyots, abyssal plains- Mid ocean ridge system, aseismic ridges. Coral reefs and their formation. Tectonic domains of oceans, island arcs, trenches, hotspot mechanism. Turbidity currents and deep sea sediments, placers on the beach and shelfs, conditions for formation of polymettalic nodules. Law of the seas.

UNIT V: Orogency-continental drift hypothesis-breakup of continents-plate tectonics-convergent and divergent margins, eustatic changes of sea level, lithosphere. subduction, obduction and benioff zones, plate margins, mineralisation near plate margin, major and minor plates. Transform and transcurent faults, driving mechanism of the plates, convection currents, triple junction, movement of Indian subcontinent. Origin and evolution of life, fossils and their uses. Biomineralisation studies on fossils, pale ecology, oxygen and carbon isotopic studies on fossils, and analysis of paleontoiogical record for tracing plate tectonic process.

Books :

1. Sub marine geology, P.H.Kunen
2. Submarine geology, F.P.Sheppard.
3. Stratigraphy of India, M.S.Krishnan
4. Structural Geology, M.P.Billings
5. Geochemistry, Rankama and Sahama
6. Economic mineral deposits, A-M.Bateman and M.N.Jenson

1. Aspects of Tectonics, focus on south central India, K.S.Valdiya

MGS-202 MATHEMATICS

Unit I: Line Integrals, Green's theorem in two-dimensions. Complex Integration, Cauchy' s Integral theorem, Cauchys Integral formula, Types of Residues, Cauchy's Residue Theorem, Evaluation of certain improper integrals involving trigonometric functions.

Unit II: Matrices: Principles and definitions, Single value decomposition method. Introduction to various generalized inversion techniques and their properties. Least square polynomial approximation: the principle of least squares, least square approximation over discrete sets of points, Chebysev Polynomial.

Unit III: Numerical Analysis; finding the roots by numerical methods- bisection method, False position method, Newton-Raphson method. Interpolation: finite difference, symbolic relations. Interpolation by Newtons formula. Gauss's Central difference formula, Bessel's formula, Lagrangian formula and Richardson's extrapolation. Numerical differentiation and Integration: Maximum and minimum of a tabulated function. Numerical Integration-Trapezoidal rule, Simpson' s rule, Romberg integration, Weddle's formula.

Unit IV: 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, Variational formulation of boundary value problem, Variational methods of approximation- The Ritz method. Introduction to finite element analysis of I-D and 2-D problems.

Unit V: Introduction to Classical Optimisation Techniques, Introduction to Linear Programming and Non-linear Programming, One dimensional minimization methods- Introduction, Fibonacci method. Introduction to unconstrained optimisation techniques. Introduction of Steepest descent method, gradient techniques and Marquardt's method.

Books :

1. Higher mathematics for Engineering and Science, M.K.Venkata Raman
2. Engineering mathematics, M.K.Venkata Raman
3. Complex Variables, R-C.Churchill
4. Matrix theory for scientific and engineers, Jennings
5. Generalized inverse of matrices and its application, C.K.Rao & S.R.Mitra
6. An Introduction to Finite Element Method, J.N.Reddy
7. Introduction to Numerical analysis, S.S.Sastry
8. Introduction to Numerical analysis, F.B.Hiderbrand
9. Optimisation theory and application, S.S.Rao

MGS 203: Computer programming

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.

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: Programming Languages: Structure of FORTRAN-77, programming 'preliminaries, compilation and execution; FORTRAN expressions-Arithmetic expressions, order of computation, use of parenthesis, value and mode of expression. Library functions-Flow Charts; Control statements - GOTO, Computed GOTO and Assigned GOTO statements; Logical expressions, different types of IF statements. DO statement. Nesting of Control statements, STOP, END and PAUSE statements; subscripted variables. Arrays and DIMENSION statement; Special statements - COMMON, DATA statements. Input and Output statements; Subprograms - Arithmetic statement functions. Function and Subroutine subprograms, Compilation and debugging.

Unit IV : BASIC programming language: Introduction, Constants, variables and expressions in BASIC; Input of data. Conditional and loop structure, control statements, GO SUB functions

UnitV: 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; Interation with Hardware through C and Operations on Bits; Some selected Geophysical problems and their C programs.

Books:

1. Fortran programming. A.K. Jain & M.N.Kesava Rao

2. Fortran 77 programming, V.Rajararnan ,

3. Let us C, Yashavant Kanetkar

4. UNIX shell programming , Yashavant Kanetkar

GS -204: 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, Blackett'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, hysterisis curve. Isolation of remnance, cleaning methods. AF demagnetization, thermal demagnetization, laboratory procedure, tests for stability.

UnitV: 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

MGS 301 : Seismic Methods-I

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

MGS 302: 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, drift correction. Problems in airborne and shipborne gravimetry, horizontal and vertical accelerations, Eotvos correction. 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.

Unit III Interpretation of gravity data – Qualitative interpretation, identification of structural features and litho contacts, two-dimensional and three-dimensional bodies - nature of anomalies. 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, Characterstics of anomalies, properties, interpretation by simple thumb rules and characteristic curves.

Unit V 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, 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.

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.

MGS 303 : PRINCIPLES OF WELL LOGGING

Unit I: Introduction: Drilling of a Well. Drilling Fluids. Mud Filterates, Invasion Profile Logging Unit. Depth Control. Well Pressures, Bore Hole Environment, Formation Factor. Porosity & Water saturations, Occurrences of Hydrocarbons, Minerals and Water, Tool design and Tool Principles.

Unit II: Electrical logging: S.P Log: Origin, Static SP, Shale Base Line, SP in various acquifers, Determination of Rw, Conventional Resistivity Logs; Normal, Lateral Curves, Focussed Logs: Latero Log - 3. Latero Log-7, DLL, SFL and Comparative study, Induction Log: DIL, HRI-High Resolution Induction Log. Micro Log, Micro & Micro Latero Log, Micro SFL. Determination of Rmf, Rxo & Rt. Dipmeter. Side Wall Coring, Logging for Ground Water, Coal & Minerals

Unit III Radioactive Logs: Principles of Radioactivity, Counters, Gamma Ray Log Statistical Variations, Neutron - Gamma,, Neutron - Neutron Logs, Thermal Decay logs, Density Log, Oxygen Log, CNT tool, SNP correction. Identification of Lithology, & Porosity. CMR Log: and identification of free fluids.

Unit IV: Sonic Logs: Transit Time, BHC tool, Sonic Velocities, Sonic Porosities Cementation. Cased Hole Logs-CBL - VDL. Identification of Water, Minerals and Hydrocarbons and fractures.

Unit V: Interpretation of Log data: Lithology & Porosity determination from cross plots. Permeability determination, M-N Plots. Common Sedimentary rocks. Clean and Shaly formations, Cross Plots Techniques, Quick look interpretation and detailed interpretation of Clean sands and Shaly sands, Water Saturation. Identification of 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.

MGS 304: MARINE GEOPHYSICS

Unit I: Oceans and Seas, origin of continents and oceans, salinity, temperature and density of sea water, 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 lithospheric deformation of central Indian ocean region, mineral resources of the sea: surficial deposits of the shelf and deep sea, heavy mineral placers, calcareous shells, pearl oysters, phosphorites, glauconite, barium sulfate carcretions, 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, for 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 Askanian, Lacoste Romberg and vibrating string gravimeters, calculation of gravity anomalies.

Unit III: Bathymetry; echosounding, bathymetric charts, bathymetry as an adjunct to geophysical surveys, submersibles, seabed mapping by side scan sonar, multibeam, lider and other surveys, seabed sampling, dredging and coring, marine geophysical surveys for sealed resources, site selection for production platforms, tunneling, waste disposal etc.

Unit IV: Oceanic magnetic anomalies, sea floor spreading, the 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. 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, lithospheric deformation in the Indian Ocean region etc. Large scale and small-scale structural features of the oceanic crust from seismic surveys (velocity structure)

Books:

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

MGS-401: 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 methodl 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 Vp/Vs as lighology 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.

MGS 402: 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.

MGS 403 : WELL LOGGING AND RESERVOIR ANALYSIS

Unit I: Reservoir Properties: Porosity, Permeability, Thickness, Temperature, Flow Types, Flow rates, Wire line sampling pressures, thief zones, Perforations, Leaks, Cement Repairs, Yield & sustainability, Water Hold – up, Slippage Velocity, Repeat Formation Tester, Modular Dynamic Tester.

Unit II: Production Logs: Thermal Decay Time Log, Temperature Log, Continuous Flow Meter, Backer Flow meter, Spinner Flow meter, Manometer, Gradio-manometer, Radio Active Tracers, Multi finger Caliper-Casing Inspection tool.

Unit III: Injection Wells: Injection rates, Temperature changes, Producing well behaviour, Tube Case analysis. Maintenance of well pressures through injection of fluids.

Unit IV: Role of Logging in Water cut and prevention-remedies, Reperforations, Re-cementations. Zone transfers. Secondary Recovery methods.

Unit V: Sustainability: Flow storages, Production planning, Re-estimation of Oil/Gas saturations in old wells using Reservoir Saturations Tool (RST) etc.

Books;

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

MGS 404 : 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 Dybnamic Suirface, K Siddhartha, Kisalaya 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