

Gravity and Magnetic Methods

1.1. Course Number: GE323

1.2. Contact Hours: 2-0-0

Credits: 6

1.3. Semester Offered: 3rd Year-Even

1.4. Prerequisite: Solid Earth Geophysics

1.5. Syllabus Committee Members: Dr. Satish Sinha and Dr. Piyush Sarkar

2. **Objective:** Understanding of gravity and magnetic methods. Distinguish between different rocks types, minerals, non-minerals and other geological signature based on gravity and magnetic method.

3. **Course Content:** Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-topics	Lectures
1	Gravity method and instrumentation	Gravitational field of the earth and its variation in Space and Time. International Gravity Formula, Factors contributing to the gravity variation on the earth's surface; Concept of gravity and micro-gravity anomaly. Gravity prospecting instruments: Stable and unstable gravimeters, borehole and airborne gravimeters.	5
2	Data Acquisition and reduction	Plan of the field surveys, station spacing, corrections for gravity data. Calculation of derivatives, continuation methods, polynomial fitting for regional-residual separation of gravity anomalies. Filter theory and filtering of potential field data, Gravity anomalies over spheres, cylinders, dykes, faults and sheets. Transformation of gravity anomalies in frequency domain, spectral representation of field data and interpretation of gravity profiles.	5
3	Interpretation of Gravity data	Quantitative interpretation of gravity anomalies due to various geological structures – dykes and faults; Forward and Inverse modeling of gravity anomalies and indirect interpretation; Concepts of 2D/2.5D and 3D density-depth models; Spectral methods in quantitative interpretation – limitation., conditions for unique gravity data interpretation.	4
4	Magnetic Method and Instrumentation	Magnetic elements, I.G.R.F., Inverse square law, concept of potential, Poisson's and Laplace's equations, magnetism on atomic scale, Dia, para, ferro magnetic materials. Susceptibilities and densities of various rocks and minerals,	5

		factors affecting density and susceptibilities, density and susceptibility determination. Magnetic prospecting instruments: flux gate, proton precession and Rubidium vapour magnetometers.	
5	Data Acquisition and Data reduction	Plan of the field surveys, station spacing, corrections for magnetic data. Calculation of derivatives, continuation methods, polynomial fitting for regional-residual separation of magnetic anomalies. Filter theory and filtering of potential field data. Magnetic anomalies over single pole, dipole, line pole, spheres, cylinders, faults and dykes, graticules and anomalies of irregular bodies. Relation between gravity and magnetic potentials, depth estimation, curve matching techniques. Transformation of magnetic anomalies in frequency domain, spectral representation of field data and interpretation of magnetic profiles.	5
6	Interpretation of magnetic data	Qualitative interpretation of magnetic data: 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; Ambiguity in magnetic model and magnetic data interpretations, conditions for unique magnetic data interpretation. Ambiguity in magnetic interpretation, generalized approach of interpretation. Joint inversion of Gravity and Magnetic data.	4
7	Application	Gravity and magnetics for the exploration of the minerals, oil /gas and groundwater.	2
Total			30

4. Readings:

4.1. Textbook:

- Grant & West : Interpretation Theory in Applied Geophysics
- Nettleton : Gravity and Magnetics in Oil Prospecting
- Rao & Murthy : Gravity and Magnetics

4.2. Reference Books:

- Dobrin & Savit: Introduction to Geophysical Prospecting
- Telford et. al: Applied Geophysics
- Murthy & Mishra : Interpretation of Gravity and Magnetic Anomalies in Space and Frequency Domain

5. Outcome of the course:

Knowledge of gravity and magnetic methods and their application for geological prospect such as identification of fault, fracture, joints, syncline/anticline etc. and classification of rocks, mineral, non-minerals and mapping of sedimentary basin etc.