Resistivity and Induced Polarization Methods

1.1. Course Number: GE 313

1.2. Contact Hours: 3-0-2   Credits: 11

1.3. Semester Offered: 3rd Year-Even

1.4. Prerequisite: Basic knowledge of Geology and Physics

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

2. **Objective:** Understanding of physical laws behind the current flow in the earth and its manifestation. Intricacies of data acquisition, interpretation and modelling for the entire spectrum of geo-electrical methods. Understanding the phenomenon of Induced Polarization (IP) in identifying the electrical chargeability of subsurface materials

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

Unit	Topics	Sub-topics	Lectures
1	General Theory	Electrical Properties of rocks, Potentials in homogenous media. Equipotential surface generated by single and two electrodes. Effects of inhomogenous ground. Analogy between optical and electrical images, Fundamental relation between potential, apparent resistivity, resistivity transform and layer distribution of a stratified earth (multiplayer).	6
2	Instrumentation and configuration	Description of the instruments used, Electrode Configuration, Geometrical constant, definition of apparent resistivity.	4
3	D.C. Resistivity Methods	Potential distribution at the surface of a horizontally stratified earth, Kernel function and its relation to the subsurface parameters, apparent resistivity function, computation of apparent resistivity model curves, principle of digital linear filtering.	8
4	Electrical Sounding and Profiling	Interpretation of resistivity VES data, empirical methods for interpretation of resistivity sounding data, indirect interpretation techniques, auxiliary point method, partial curve matching, complete curve matching, direct interpretation techniques, automatic direct interpretation method, Dar Zarrouk parameters, inversion techniques in resistivity method of interpretation, computer-aided resistivity data interpretation (softwares), principles of equivalence, suppression and detectibility problems,	10

		effects of deviations from the fundamental assumptions. Profiling near a vertical contact and thin vertical dykes and discussion of the expected apparent resistivity curves.	
5	Self-Potential (SP) Method and Induced polarization (IP) method	SP: Mechanism of SP, field techniques, field due to vertically polarized sphere and interpretation. IP: Introduction, Sources of IP, Membrane polarization, Electrode polarization, Time and Frequency Domain measurements. Chargeability, Frequency effect and metal factor. Apparent Chargeability over layered earth, Application in Hydrocarbon Exploration	9
6.	Other methods	Principles, application and interpretation of potential drop ratio method, equipotential lines method and telluric current methods.	3
		Total	**40**

4. Readings:

4.1. Textbook:

- Dobrin, M. B., and Savit, C. H., Introduction to Geophysical Prospecting (Fourth Edition), Tata McGraw Hill.
- Telford, W. M., Geldart, L. P., Sheriff, R. E., and Keys, D. A.., Applied Geophysics.

4.2. Reference Books:

- Parasnis, D. S., Principles of Applied Geophysics (Fifth Edition), Chapman and Hall.
- Bhattacharya, B. K., and Patra, H. P., Direct Current Electric Sounding (Methods in Geochemistry and Geophysics) Elsevier Publishing Co.

5. Outcome of the course:

The purpose of this course is to familiarize students with the resistivity and induced polarization methods which are extensively used in hydrogeological, environmental, geotechnical aspects of civil engineering, engineering geology and in mining engineering problems. The ultimate goal of the course is to solve geological problems by understanding the concepts of physics using electrical signature.