Course Type	Course Code	Name of Course	L	T	P	Credit
DC	NGPC513	Geophysical Methods	3	1	0	4

Course Objective
The main objective of the course is to provide students with a basic understanding of the principles, techniques, and applications of various geophysical methods used in Earth sciences.
Learning Outcomes
Students should be able to (i) understand and explain the fundamental principles behind various geophysical methods and (ii) decide on the application of geophysical methods to solve real-world geological problems.

Unit No.	Description of lectures	Lecture hrs.	Learning outcomes
1.	Basic principles of geophysical exploration, Overview of geophysical exploration methods, its principles and limitations; introduction to the Internal structure of Earth, role of geophysics in Earth sciences, historical development of geophysical methods.	3	Knowledge on principles and limitations of geophysical exploration methods.
2.	Introduction to gravity method: Basis for gravity exploration, concept of geoid & spheroid, gravitational field, densities of common rocks, determination of density. Gravimeters: principle of operation of unstable gravimeters, zero length spring, La-Coste-Romberg and Worden gravimeters. Gravity data reduction, International gravity formula, Gravity anomaly of simple shaped-bodies, Land, airborne and shipborne gravity surveyings & interpretation of gravity anomaly. Application of gravity method.	6	Basic understanding of Earth's gravity field, principles of different gravimeters, gravity survey practices, data processing techniques, and interpretation procedures.
3.	Introduction to magnetic method: Basic concepts of magnetic method, nature of the geomagnetic field, magnetic properties of rocks and minerals. Magnetometers: Fluxgate, and proton precession magnetometers, magnetic gradiometers. Land, airborne and shipborne magnetic surveyings. Marine magnetic anomaly and geomagnetic polarity reversal time scale, Reduction of magnetic data, and interpretation of magnetic anomaly. Application of magnetic method, case studies and challenges.	6	Fundamental knowledge of the Earth magnetic field. Principles of magnetic instruments, survey procedures, data processing techniques and interpretation procedures.
4.	Seismic methods: Basic principles of seismic wave propagation, types of seismic waves, effects of the medium on wave propagation. Elementary principle of the seismic reflection and refraction methods. Seismic energy sources and receivers for land and marine environments; Various field procedure and survey configuration: broadside shooting, fan shooting, end-on shooting and split spread arrangements. Travel time curves for two layered earth- horizontal and dipping interface. Basic seismic data processing steps, attenuation of noise and multiples, types of seismic trace display. Overview of the seismic data interpretation procedure.	7	Foundations of wave propagation, principles of seismic instruments, various seismic field configurations, data processing techniques, and interpretation procedures.

5.	Overview and types of electrical methods, electrical properties of rocks and minerals, Relationship between resistivity, conductivity and geologic properties, elementary principles of Self-Potential (SP), Induced Polarization (IP), Direct Current (DC) Resistivity, and Electromagnetic (EM) Methods. Basic data processing and interpretation.	**6**	Gain a comprehensive overview of various electrical methods used in geophysics, including their principles and applications.
6.	Radiometric method: Basic principles of radioactivity, radioactive techniques for geophysical exploration, Interpretation of radiometric data, Responses of mineralized environments, and radiometric prospecting for diamonds, and beach placer deposits.	**5**	Gain proficiency in radiometric method for geophysical exploration, including interpreting radiometric data and applying them to identify mineralized environments.
7.	Geophysical well-logging method: Objectives of well logging, Borehole environment, surface logging setup; Sources of SP in wellbore, Archie's law and Darcy's law. Introduction of Basic well logs and its interpretation. Cases studies show well log interpretation in different geological conditions.	**6**	Develop expertise in geophysical well- logging methods, covering the objectives, borehole environment, and surface logging setup.
8.	Integrated geophysical approach: Importance of integrating multiple geophysical techniques for a comprehensive understanding, Case studies showcasing integration of multiple geophysical methods.	**3**	Basic knowledge on the importance and practical application of integrating multiple geophysical techniques for a comprehensive subsurface evaluation.
	Total:	**42L + 14T**	

Textbooks

1. Lowrie, W., Fundamentals of Geophysics, Cambridge Univ. Press, 2007.
2. Philip, K., Brooks, P., Hill, I. An introduction to Geophysical Exploration, Black well Science, 2002.
3. Telford, W.M., Geldart, L.P., Sheriff, R.E. Applied geophysics, Cambridge University Press, 1990.

Reference Books

1. Anderson, D., New Theory of the Earth, Cambridge University Press, 2007.
2. Jones, E.J.W. Marine Geophysics, John Wiley & Sons, 1999.
3. Fowler, C.M.R., The Solid Earth: An Introduction to Global Geophysics, Cambridge University Press, 2005.
4. Howell, B. F., Introduction to Geophysics, Mc-Graw Hill, 2012.
5. Philip K., Stacey F. and Davis P., Physics of the Earth, Cambridge University Press, 2008.
6. Stanislav M., Tvrdy, S. Introduction to applied geophysics, Springer Dordrecht, 1984.