Course Type	Course Code	Name of Course	L	T	P	Credit
DP	NGPC533	**Geophysical Inversion Practical**	0	0	2	1

Course Objective

This practical will provide the knowledge of foundation of inverse theory and various practical aspects for solving inverse problems in applied geophysics. Clear understanding of data model relationship, local and global optimization techniques, model-based inversion, data-driven inversion, regularization and concepts of Bayesian theory for stochastic inversion.

Learning Outcomes

The primary objective of the course is to introduce fundamental and advanced aspects of inversion for geophysical exploration. At the end of the course, with acquired knowledge, students will be able to solve the linear and non-linear geophysical inverse problems for geophysical exploration.

Unit No.	Details of Lectures	Lectures Hrs.	Outcome
1.	Formulate 1D/ resistivity/IP forward problem and compute the sensitivity matrix.	**2**	Formulation of forward problem
2.	Calculate damping factors for damped least-squares inversion.	**2**	Understanding importance of damping factor
3	Estimate delay time parameters in exploration seismology	**2**	Calculation of time delay parameters
4.	Compute the sensitivity matrix of amplitude variation with offset (AVO) for isotropic /anisotropic reflector	**2**	Sensitivity matrix calculation
5.	Develop steepest descent (SD) and Gauss Newton (GN) method to invert 1Dresistivity/MT data. Apply SVD for VES data inversion	4	Inversion of data using different methods
6.	Use conjugate gradient (CG)/Lavenberg-Marquardt (LM) to invert noisy geophysical data.	2	Data inversion using CG/LM methods
7.	Compute data resolution and model resolution matrix and understand their importance.	2	Understanding resolution matrix
8.	Use singular value decomposition to invert a near singular matrix-solving Christofel equation for homogeneous isotropic medium.	2	Application of SVD method
9.	Develop an algorithm for particle swarm optimization (PSO) simulated annealing (SA)/ Very Fast SA (VFSA).	2	Development of algorithm-1

10.	Develop Markov-Chain Monte Carlo (MCMC) algorithm to invert multi-parameter data.	2	Development of Algorithm -2
11.	Develop Genetic Algorithm (GA), and Neural Network (NN) and Bayesian neural networkalgorithm (BNN).	2	Development of Algorithm -3
12.	Evaluate the performances of local search and global search algorithms.	2	Comparison of efficiency of local/ global search
13.	Develop hybrid algorithms for inversion of non-linear geophysical problems.	2	Understanding non-linear geophysical problems
	Total	**28**	

Textbooks

1. Menke, W., 1989, Geophysical data analysis: Discrete inverse theory, Academic Press, International Geophysical series, Vol. 45, 3rd Edition. MATLAB Edition
2. Sen, M.K., 2013, Global Optimization Methods in Geophysical Inversion. Second Edition.

Reference Books

1. Gubbins, D. 2004, Time series analysis and Inverse theory for Geophysicists, Cambridge Univ. Press,
2. Scales, J. A., Smith M. L. and Trietel, S., 2001, Introductory Geophysical Inverse Theory, Samizdat Press, Golden Colarado, USA,
3. Tarantola, A, 1987, Inverse Problem Theory, Elsevier Publishers, New York.