Inverse Problems - Course Syllabus

Course Number: ErSE 213

Course Title: Inverse Problems

Academic Semester:	Spring	**Academic Year:**	2015/ 2016
Semester Start Date:	Jan 24, 2016	**Semester End Date:**	May 19, 2016

Class Schedule: Mon - Wed: 10:30 - 12:00

Classroom Number:

Instructor(s) Name(s): Ibrahim Hoteit
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Office Hours:
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COURSE DESCRIPTION FROM PROGRAM GUIDE

This course will introduce the principles of Inverse theory and data assimilation with applications to geophysics and other sciences. Both deterministic and stochastic viewpoints will be covered. Subjects studied will include topics such as least squares, generalized inverses, regularization, Kalman filter, adjoint method, etc. Techniques for solving nonlinear inverse and data assimilation problems will be also covered (200- level for Master students, 300-level for Ph.D. students with more home- and project work).

COMPREHENSIVE COURSE DESCRIPTION

Inverse theory refers to the mathematical techniques used to determine the parameters of a model that describes a set of observed data. This course will introduce the principles of the inverse theory with applications to geophysics and other sciences. Both deterministic and statistical viewpoints will be covered.

Subjects studied will include topics such as least squares, generalized inverses, regularization, resolution, etc. Techniques for solving nonlinear inverse problems will be covered.

GOALS AND OBJECTIVES

The goal of this course is to provide an overview of important techniques used for the analysis, regularization, and numerical solution of inverse problems.

Upon completion of this course, the student should

• Be able to apply commonly used algorithms and techniques for analyzing and computing the solution of inverse problems,

• Have seen and discussed examples of inverse problems in a variety of fields,

• Have completed a computational inverse problems project.

REQUIRED KNOWLEDGE

– Strong background in linear algebra.

– Good understanding of probability theory.

– Good skills in multivariate calculus (gradients, Hessians, etc).

– Strong programming skills in Matlab.

REFERENCE TEXTS

William Menke: Geophysical Data Analysis: Discrete Inverse Theory. Academic Press, New York, pp. 289, 1989, ISBN-10: 0-12-490921-3

Richard Aster: Parameter Estimation and Inverse Problems. Academic Press, pp. 302, 2005, ISBN: 0-12-065604-3

Carl Wunsch: Discrete Inverse and State Estimation Problems. Cambridge University Press, pp.384, 2006, ISBN: 0521854245.

METHOD OF EVALUATION

Graded content
– Attendance and students participation during class: 10% – Homework Assignments & Quizzes: 30% – Midterm Exam: 40% – Projects: 20% of the total grade.

COURSE REQUIREMENTS

Assignments

Written assignment every 3 weeks in the form of between class homeworks that will primarily consist of using Matlab to solve various inverse problems.
Final inverse problem project. This can involve data you have collected from a simulation and/or experiment, or the development of a new
software tool(s) for inverse problems.

Course Policies

No late homeworks

Additional Information

NOTE
The instructor reserves the right to make changes to this syllabus as necessary.