

**Course Number: 28143**  
**Course Name: INVERSE HEAT TRANSFER**

Course Type: Theory
Prerequisite: Undergrad heat transfer
Level: Graduate
Group: Energy Conversion

Type & Max Unit: Constant 3
Corequisite: Nothing
First Presentation: 2016-1
Last Edition: 2017-1

**Objectives:**

The goal of this course is to maintain a balance between theory, numerical computation, experimental results and optimization techniques in heat transfer problems. Students will learn to formulate and analyze ill-posed inverse heat transfer problems and apply inverse heat transfer techniques to solve them. In addition they will learn the basic mathematical principles on which these techniques are based. After completing this course, student will be able to apply these techniques not only in heat transfer problems, but also on any optimization problem they face during the course of their graduate studies and future research.

**Topics:**

- 1- Introduction
  - 1-1 History and development of inverse heat transfer problems
  - 1-2 Application of inverse heat transfer problems in engineering
  - 1-3 Introduction to optimization
- 2- Statistical description of error
- 3- Definition of sensitivity coefficient
- 4- Classification of inverse problems
- 5- Approximate methods for direct heat conduction problems
- 6- Exact solution of the inverse heat conduction problems
- 7- Sequential function estimation methods
- 8- Whole domain estimation
- 9- Regularization methods
- 10- Gradient based methods
  - 10-1 Calculation of gradient
  - 10-2 Steepest descent method
  - 10-3 Box-Kanemasu method
  - 10-4 Marquardt's method
  - 10-5 Conjugate gradient method
  - 10-6 Adjoint problem
- 11- Introduction to non-gradient-based optimization methods
  - 11-1 Introduction to Neural network
  - 11-2 Introduction to Genetic Algorithm

**References:**

- 1- Parameter Estimation in Engineering and Science, J.V. beck, K.J. Arnold
- 2- Inverse Heat Conduction – Ill-posed problems, J.V. Beck, B. Blackwell, and C. Clair
- 3- Inverse heat transfer, M. Necati Özişik