



**THE OHIO STATE UNIVERSITY**  
COLLEGE OF ENGINEERING

# Nonlinear and Dynamic Programming for ECE

## ECE 5500

**Credit Hours:**

3.00

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**Course Levels:**

Undergraduate (1000-5000 level)

Graduate (5000-8000 level)

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**Course Components:**

Lecture

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**Course Description:**

Introduction to Optimization, including unconstrained optimization, gradient descent, Newton's method, convexity, constrained optimization, KKT, duality, dynamic programming, basic reinforcement learning, and applications of optimization in ECE.

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**Prerequisites and Co-requisites:**

Prereq: Math 2568 and MATH 2415; or Grad standing in Engineering or Math and Physical Sciences.

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**Course Goals / Objectives:**

- Master computational and mathematical methods for optimization to solve engineering problems
  - Be exposed to posing engineering problems as optimization problems
  - Be competent with arguing which algorithm is suitable for solving a given optimization problem
  - Be familiar with convergence techniques for optimization algorithms
  - Be exposed to modern software packages for numerical optimization, such as MATLAB or Python
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**Course Topics:**

- Overview of basic background
  - Convex functions and convex sets, definition of global and local optimality
  - Unconstrained optimization, gradient methods and convergence properties, second-order algorithms such as Newton's method and convergence
  - Constrained optimization, Lagrange multiplier theorem and KKT conditions, duality, penalty method
  - Applications in electrical and computer engineering: deep learning, communications, estimation, and/or electro-magnetics
  - Dynamic programming, approximate dynamic programming, reinforcement learning
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**Designation:**

Elective