# EE 417: Introduction to Optimization

**Credits:** 3
**Categorization of credits:** engineering topic
**Instructor:** J. Yee
**Textbook and Other Required Materials:** "Introduction to Mathematical Programming, 4th edition" by Wayne L. Winston and Munirpallam Venkataramanan, Thomson Brooks-Cole.
**Alternate textbook:** "Introduction to Operations Research, 9th edition" by Hillier and Lieberman, McGraw-Hill, 2005.

**Catalog Description:** Application of linear, nonlinear and integer optimization models and algorithms to communications, control, signal processing, computer networking, financial engineering, manufacturing, production and distribution systems.
**Prerequisites:** Math 307 Linear Algebra and Differential Equations
**Designation**: Elective
**Class/Lab Schedule:** 3 lecture hours per week

**Topics Covered:**
EE417 is an undergraduate course on the theory and practice of optimization. We will survey the various classes of optimization problems which includes linear programming, integer programming, and nonlinear programming. We will present optimization models, some theory and a variety of optimization algorithms. We will discuss the computational complexity of various algorithms. An emphasis will be the formulation of real-world problems and the utilization of software implementations of various algorithms to solve problems. We consider the application of optimization theory to computer networks, communications, computers, finance, transportation, logistics, manufacturing, project management and several other domains. This course fits into academic programs in EE, Management (operations research/management science), Computer Science, Math, CE and ME. This course can be used as a Systems Elective or a TE. The topics covered are

- Introduction to Model Building/Review of Linear Algebra (2 hours)
- Introduction to Linear Programming (3 hours)
- The Simplex Method and Goal Programming (6 hours)
- Sensitivity Analysis and Duality Theory (7 hours)
- Transportation and Assignment Problems (4 hours)
- Network Models (7 hours)
- Integer Programming (9 hours)
- Nonlinear Programming (4 hours)
- Optimization Software (2 hours)

**Course Objectives and Their Relationship to Program Objectives:**
The student is introduced to optimization models and algorithms. The student develops an ability to recognize optimization problems that arise in engineering practice or management and to identify which type of model and algorithm would be appropriate. The student learns how to use academic and commercial software to calculate solutions or designs for his/her recommendation to management.
[Program Objectives this course addresses: 1, 2, 3 and 5.]

**Course Outcomes and Their Relationship to Program Outcomes:**
The following are the course outcomes and the subset of Program Outcomes (numbered 1-7 in square braces "[ ]") they address:

- Understand optimization models and review of Linear Algebra. [1, 2]
- Understand linear programming models and develop an ability to formulate real-world problems as LPs. [1, 2, 4]
- Understand the Simplex Method, Sensitivity Analysis and Duality Theory. [1, 2]
- Understand specialized graph-theoretic models (transportation, assignment, network flow) known for their excellent computational efficiency and applicability. [1, 2]
- Understand integer programming models and associated algorithmic methods. [1, 2]
- Understand nonlinear programming models and associated algorithmic methods. [1, 2]
- Use MatLab and Excel to compute solutions. [1, 2, 6]

**Contribution of Course to Meeting the Professional Component**
Engineering Topics: 100%

**Computer Usage:**
Students use MatLab and Excel to compute solutions to mathematical models that represent real-world engineering and management problems.

**Design Credits and Features:**
EE 417 currently has .5 units of design credit. In this course, the students develop an understanding of how to apply optimization theory to engineering design.

**Person Preparing Syllabus and Date:** J. Yee, October 10, 2014. Y.Dong, Jun 15th, 2021.