Course name	**ECE 58000 Optimization Methods for Systems and Control**
Credit and contact hours	(3 cr.) Class 3
Course coordinator's name	Sarah Koskie
Textbook	E.K.P. Chong and S.H. Zak, *An Introduction to Optimization*, 4th Ed., Wiley, 2013. ISBN: 9781118279014
Course information	ECE 58000 Optimization Methods for Systems and Control (3 cr.) P: Consent of Instructor or graduate standing. Class 3. Introduction to optimization theory and methods, with applications in systems and control. Nonlinear unconstrained optimization, linear programming, nonlinear constrained optimization, various algorithms and search methods for optimizations, and their analysis. Examples from various engineering applications are given. **Prerequisites/ Co-Requisite** Graduate standing or consent of instructor **Required, Elective, or Selected Elective:** EE Elective, CE Elective
Goals for the course	Upon successful completion of the course, students should be able to 1. Formulate optimization problems and identify possible solution methods for such problems. [1, 6] 2. Apply and analyze basic linear and nonlinear optimization algorithms. [1] 3. A background needed to understand more advanced optimization techniques. [7] 4. An ability to make formal and rigorous arguments in analyzing optimization problems and solution techniques. [1]
List of topics to be covered	1. Introduction: examples from real world problems, notation. (1 class) 2. Math preliminaries: notation, real vector spaces, linear independence, matrices, inner product, norm, eigenvalues and eigenvectors, quadratic forms, calculus of several variables, chain rule, Taylor series, gradient, directional derivative. (1 classes) 3. Basics of unconstrained optimization: definition, types of solution, FONC/SONC. (2 classes) 4. One-dimensional search methods: Golden section search, Newton's method, secant method. (2 classes) 5. Multi-dimensional algorithms: gradient methods: form, steepest descent. (2 class) 6. Multi-dimensional algorithms: Newton's method: form, order of convergence. (2 class)

	7. Multi-dimensional algorithms: Conjugate direction methods. (1 class) 8. Multi-dimensional algorithms: Quasi-Newton method. (2 classes) 9. Least squares problems: basic properties, examples, parameter identification. (2 classes) 10. Global search algorithms: simulated annealing, GA, particle swarm optimizer. (3 classes) 11. Constrained optimization: basic concepts, definition, LP basics. (2 classes) 12. Simplex method. (4 classes) 13. Nonlinear constrained optimization with equality constraints. (2 classes) 14. Nonlinear constrained optimization with equality and inequality constraints. (2 classes) 15. Convex optimization problems. (1 class) 16. Numerical algorithms for constrained optimization. (1 class) 17. Advanced topics. (1 class)
Syllabi approved by	Sarah Koskie
Date of approval	08/20/2019