Utah State University

DigitalCommons@USU

Fall 2015

Engineering Optimization: Methods/Applications - Colorado State University

John Labadie
Colorado State University, labadie@engr.colostate.edu

Follow this and additional works at: https://digitalcommons.usu.edu/ecstatic_all

Part of the Civil Engineering Commons

UtahStateUniversity
MERRILL-CAZIER LIBRARY

ENGR 510 – Engineering Optimization: Methods/Applications

Instructor:
J.W. Labadie
Professor of Civil and Environmental Engineering
B211 Engineering
Phone: (970)491-6898
Fax: (970)491-7727
Email: labadie@engr.colostate.edu

Office Hours:
MWF 10:00 - 11:30 am (or by appointment)
[Note: students may phone or email the instructor at any time for help]

Class Time/Place:
Mon & Wed; 4:00---5:15pm; Room B2, Engineering Building

Prerequisites:
M 160 (Calculus for Physical Scientists II) and M 229 (Matrices and Linear Equations), or equivalent background in calculus and linear algebra

Required Textbook:
I. Girva, S. Nash and A. Sofer*, Linear and Nonlinear* Optimization, 2nd Ed., Society for Industrial and Applied Mathematics, Philadelphia, PA, 2009 [ISBN 978-0-898716-61-0]

Computing:
Students should have facility in using Microsoft EXCEL spreadsheet software; experience in development of macros and facility with Solver in EXCEL is useful, but no other programming experience required.

Grading: (approx.)
30% Weekly homework assignments
30% Midterm examination
40% Final exam

Objectives: This course provides a comprehensive treatment of methods of optimization with focus on linear programming and its extensions, network flow optimization, integer programming, quadratic programming, and an introduction to nonlinear programming. The goal is to maintain a balance between theory, numerical computation, problem setup for solution by computer algorithms, and engineering applications.

Course Schedule

ENGR 510 – Engineering Optimization: Methods and Applications
Fall 2015

Lecture Number	Date	Lecture	Reading
1	Aug 25	Introduction to optimization; Systems; Approach; History of OR	Ch. 1
2	Aug 27	Overview of optimization	2.1 - 2.3
3	Aug 31	General optimization problem; Feasible directions; Necessary conditions for local optima	2.4 – 2.6
4	Sep 2	Sufficient conditions; Convex functions and sets; Convex combinations	2.7
--	Sep 7	**HOLIDAY – NO CLASSES**	
5	Sep 9	Geometry of linear programming; Graphical solutions; Example WDS application	Ch. 4
6	Sep 15	Standard form of linear programming; Basic solutions	Lecture Notes
7	Sep 16	Fundamental theorem of linear programming; Example	5.1
8	Sep 21	Simplex method; Canonical form; Pricing out	5.2
9	Sep 23	Ratio test; Pivoting	5.3
10	Sep 28	Lexicographical tie-breaking procedure; Proof of finite convergence	5.4
11	Sep 30	Phase I Simplex; Degeneracy; Revised simplex method	5.5
12	Oct 5	Introduction to duality theory; Strong duality theorem	6.1, 6.2
13	Oct 7	Primal-dual relationships; Symmetric form of the dual	6.4
14	Oct 12	Complementary slackness; Economic interpretation of dual	Lecture Notes
15	Oct 14	Sensitivity analysis; RHS ranging; Application in industrial engineering: blending problem	Lecture Notes
--	Oct 19	*****MIDTERM EXAMINATION***** (this date for on-campus students)	
16	Oct 21	Application in engineering statistics: multiple regression and model building	Lecture Notes

17	**Oct 26**	Application in control engineering: dynamic systems optimization; Application in environmental engineering: optimal estimation	Lecture Notes
18	**Oct 28**	Application in industrial engineering: production planning; Application in transportation engineering	Lecture Notes
19	**Nov 2**	Introduction to network flow optimization; Application in water resources engineering	8.1 - 8.4
20	**Nov 4**	Primal-dual algorithm for network flow optimization	Lecture Notes
21	**Nov 9**	Out-of-kilter method; Primal and dual phases	Lecture Notes
22	**Nov 11**	OKM--example problem	Lecture Notes
23	**Nov 16**	Introduction to integer programming; Branch and bound method	10.1 - 10.4
24	**Nov 18**	Application: Irrigation scheduling using binary programming	10.5
--	**Nov 23-Nov 27**	**HOLIDAY – NO CLASSES**	
25	**Nov 30**	Introduction to interior point optimization; Affine scaling	14.1 -14.3
26	**Dec 2**	Karmarkar method for Phase I of interior point optimization	14.4 -14.7
27	**Dec 7**	Necessary and sufficient Conditions for constrained nonlinear optimization	Lecture Notes
28	**Dec 9**	Quadratic programming; Lemke's complementary pivot algorithm	Lecture Notes