Convex Analysis (Math 580) Syllabus

Term 141, Year 2014/15

Instructor Information

Instructor	Email	Office Location & Hours
Dr. Mohammed Alshahrani	mshahrani@kfupm.edu.sa	Building 5, Room 201-1, Tel: 013-860-7748 Office hours: Mondays & Wednesdays 05:00-05:50 PM

General Information

Description

Convex sets and convex functions; epigraphs, level sets. Inf-convolution; continuity and semi-continuity. Separation theorems and the Hahn-Banach theorem. Representation theorems, Caratheodory theorem. Polyhedra. Farkas lemma. Fenchel's theorem. Applications to linear systems. The weak duality theorem. Convex systems. Differentiability. Subdifferentials and subgradients, generalized gradients. Inf-compactness. Applications to Math programming and control theory. Cones of tangent. Constraint qualifications and optimality conditions for nonsmooth minimization problems.

Course Materials

Required Text

Convex Analysis and Optimization, D.P. Bertsekas, Belmont, MA: Athena Scientific, 2003.

Optional Text

1. Mathematics of Optimization: Smooth and Nonsmooth Case, G. Giorgi, A. Guerraggio and J. Thierfelder, Elsevier 2004, ISBN-13: 978-0-444-50550-7.
2. An Easy Path to Convex Analysis and Applications Synthesis Lectures on Mathematics and Statistics, Vol. 6, No. 2. (21 December 2013), pp. 1-218, doi:10.2200/s00554ed1v01y201312mas014 by Boris S. Mordukhovich, Nguyen M. Nam
3. Convex Optimization (2004) by Stephen Boyd, Lieven Vandenberghe.

Resources:

This course will be supplemented by the following websites

- My personal website: http://faculty.kfupm.edu.sa/MATH/mshahrani/
- BlackBoard: (Version 9.1 on https://blackboard.kfupm.edu.sa/)
  Syllabus, Lecture Notes, Homework Problem Sets, Grades, Attendance, etc.

Grading Policy

Evaluation

Activity	Points
Homework	200
Exam 1	100
Exam 2	100
Exam 3	200
Total	600

Grading Scale

Grade	Range
A+	570-600
A	540-569
B+	500-539
B	450-499
C+	390-449
C	350-389
D+	320-349
D	300-319

Course Schedule

Week	Topic	Reading
0	Review: Linear Algebra & Real Analysis	1.1
1	Convex Sets and Functions Convex and Affine Hulls	1.2 1.3
2	Relative Interior, Closure, and Continuity Recession Cones	1.4 1.5
3	Global and Local Minima Directions of Recession and Existence of Optimal Solutions.	2.1 2.3
4	Hyperplanes Elementary Form of Duality	2.4 2.5
5	Saddle Points and Minimax Theory	2.6
6	Polar Cones Polyhedral Cones and Polyhedral Sets	3.1 3.2
7	Extreme Points Polyhedral Aspects of Optimization	3.3 3.4
8	Polyhedral Aspects of Duality	3.5
9	Directional Derivatives Subgradients and Subdifferentials	4.1 4.2
10	Conical Approximations Optimality Conditions	4.6 4.7
11	Introduction To Lagrange Multipliers Enhanced Fritz John Optimality Conditions	5.1 5.2
12	Informative Lagrange Multipliers Pseudonormality and Constraint Qualifications	5.3 5.4
13	Exact Penalty Functions Using The Extended Representations	5.5 5.6
14	Geometric Multipliers Duality Theory Linear And Quadratic Programming Duality Strong Duality and the Duality Function	6.1 6.2 6.3 6.5
15	Conjugate Functions The Fenchel Duality Theorem Exact Penalty Functions	7.1 7.2 7.3

Exam Schedule

Exam	Date & Time	Subject
1	Thursday, October 23, 2014 **(03:30-05:30PM)**	Chapters 1 & 2
2	Thursday, November 27, 2014 **(03:30-05:30PM)**	Chapters 3 & 4
3	Sunday, January 4, 2015 **(07:00-10:00)**	Chapters 5, 6 & 7