

Syllabus

Convex Analysis (MATH 580)

KFUPM - Department of Mathematics & Statistics 2020-2021
(201)

Instructor: Izhar Ahmad

Course Description: Convex sets. Relative interior. Separation of convex sets. Convex functions. Examples of convex functions. Characterization of convex functions. Normal cone, tangent cone. Asymptotic cone. Advanced properties of convex sets: Caratheodory, Radon, Helly theorems, Farkas lemma. Continuity and differentiability of convex functions. Subgradients and subdifferential. Convex optimization: Optimality conditions, constraint qualification.

Reading material Textbook: B.S. Mordukhovich, *An Easy Path to Convex Analysis and Applications*. Morgan and Claypool (2014).
Other books: J.B. Hirriart Urruty and C. Lemaréchal: *Fundamentals of Convex Analysis*. Springer (2001). (Comprehensive and well-written).
D.P. Bertsekas, *Convex Analysis and Optimization*, Belmont, MA: Athena Scientific, 2003.
T. Rockafellar, *Convex Analysis*. Princeton University Press (original edition 1970, re-edited many times). The absolute classic: 19.500 citations!

Objectives/Learning Outcomes: The course aims to familiarize the students with the theory of convex sets and functions, and with their applications to extremum problems.

Credit hours: 3

Evaluation scheme:

Midterm Exam	30%
Homework assignments	20%
Presentations	10%
Project	5%
Final Exam	35%

Total: 300 points

Grading scale	Grade	Range
	A ⁺	270 – 300
	A	249 – 269
	B ⁺	225 – 248
	B	207 – 224
	C ⁺	192 – 206
	C	174 – 191
	D ⁺	160 – 173
	D	150 – 159

Course schedule

Week	Topic
30/8–03/9	Convex sets. Convex functions.
06/9–10/9	Convex functions (continued). Relative interior.
13/9–17/9	The distance function. Separation of convex sets.
20/9–22/9	Normal cones. Continuity of convex functions.
27/9–01/10	Subdifferential.
04/10–08/10	Subdifferential (continued).
11/10–15/10	Subdifferential calculus.
18/10–22/10	Fenchel conjugate. Differentiability of convex functions.
25/10–29/10	Directional derivatives
01/11–05/11	Characterizations of differentiability
08/11–12/11	Advanced properties of convex sets: Caratheodory theorem, Farkas lemma, Randon theorem and Helly theorem.
15/11–19/11	Lower semi-continuity and existence of minimizers.
22/11–26/11	Constraint qualifications.
29/11–03/12	Optimality conditions.
06/12–10/12	Applications
13/12-15/12	Revision

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