Department of Mathematics & Statistics
Concordia University

MATH 479 (MAST 661/837) Sec. A
Convex and Non-Linear Analysis
Fall 2020

Note: **This course will be entirely ONLINE with the lectures organized on the Zoom platform.**

Instructor: Dr. A. Stancu
Email: alina.stancu@concordia.ca

Office Hours: The professor will announce in class the hours during which there will be help available on the material of the course. The office hours will also be held on Zoom. Note that, if a student misses a lecture, the professor will not use office hours to make up for the student's missed class. Office hours are to clarify and better assimilate the material of the course that the student tried first to understand from the lecture or textbook in an individual study.

References: The course will consist of a selection of topics listed on the next page for which you may consult the following sources (all e-books):

1. *Convex functions and their applications: a contemporary approach* by C. P. Niculescu and L.-E. Persson, Springer (2018) **E-link at Concordia's library.**

2. *Convex Optimization* by Boyd and Vanderberghe, Cambdridge University Press (2004), available on Dr. Boyd's web page at Stanford University (check also the book's errata on the same web page for possible typos).

3. *Selected Topics in Convex Geometry* by Maria Moszynska, Birkhauser (2006) **E-link at Concordia's library.**

4. *Convex and discrete geometry* by Peter M. Gruber, Springer (2007) **E-link at Concordia's library.**

Topics: Starting with classical properties of convex sets and functions, the course aims to present several classical inequalities like the Brunn-Minkowski inequality and its related functional form, Prekopa-Leindler, the Blaschke-Santaló inequality, the Urysohn inequality, as well as more recent results such as the reverse isoperimetric inequality, and the Brascamp-Lieb inequality and its

reverse form. In the process, we will touch upon log-convex functions, duality for sets and functions and, generally, extremum problems.

A tentative schedule is listed below. The schedule is subject to change during the term in order to adjust to the mathematical interest and background of the audience.

Week	Topics
1 - 3	Convex sets; separation theorems; polar sets; John's Theorem.
4 - 6	Convex functions; criteria of convexity for differentiable functions; inequalities for convex functions; conjugate functions.
7 - 8	Brunn-Minkowski Theorems. - **Midterm** -
9 - 10	Steiner symmetrization; other symmetrizations; applications such as Grünbaum's Theorem.
11 - 13	Mixed volumes and applications such as Minkowski's first inequality.

Grading: **Homework (20%), Midterm (30%) and Final Exam (50%).** Part of the course evaluation may include an oral component in which the student meets with the professor to answer questions on the solutions submitted.

Graduate students will be required to do extra work in these evaluations.

The homework will be assigned approximately every two weeks during class and posted on Moodle. It is the student's responsibility to upload the assignment on Moodle on time. **No late assignments will be accepted. No submissions by email will be accepted either.**

If the grading scheme for this course includes graded assignments, a reasonable and representative subset of each assignment may be graded. Students will not be told in advance which subset of the assigned problems will be marked and should therefore attempt all assigned problems.

A midterm exam will be held in class on Tuesday, October 27, 2020 covering the material taught during the first six weeks of classes.

It is the Department's policy that tests missed for any reason, including illness, cannot be made up. However, if a student misses the midterm because of illness confirmed by a valid medical note, the final exam can count for 80% of student's final grade, and 20% will be considered from the evaluation of the student's assignments (as per the **Grading scheme above**).

Final Note: Active participation in classes and continuous work on the course material throughout the term is important for success in this course. Read the course material and do the assignments on your own. By assuming a responsible behaviour (see also the **Academic Integrity and the Academic Code of Conduct** below), you will also achieve a better understanding of the material.

Academic Integrity and the Academic Code of Conduct

This course is governed by Concordia University's policies on Academic Integrity and the Academic Code of Conduct as set forth in the Undergraduate Calendar and the Graduate Calendar. Students are expected to familiarize themselves with these policies and conduct themselves accordingly. "Concordia University has several resources available to students to better understand and uphold academic integrity. Concordia's website on academic integrity can be found at the following address, which also includes links to each Faculty and the School of Graduate Studies: concordia.ca/students/academic-integrity." *[Undergraduate Calendar, Sec 17.10.2]*

Content belonging to instructors shared in online courses, including, but not limited to, online lectures, course notes, and video recordings of classes remain the intellectual property of the faculty member. It may not be distributed, published or broadcast, in whole or in part, without the express permission of the faculty member. Students are also forbidden to use their own means of recording any elements of an online class or lecture without express permission of the instructor. Any unauthorized sharing of course content may constitute a breach of the Academic Code of Conduct and/or the Code of Rights and Responsibilities.

Disclaimer: In the event of extraordinary circumstances beyond the University's control, the content and/or evaluation scheme in the course is subject to change.