

**MATH 479 (MAST 661) Sec. A**  
Convex and Non-Linear Analysis  
*Fall 2022*

**Instructor:** Dr. A. Stancu, Office: LB 921-23 (SGW), Phone: (514) 848-2424, Ext. 3230  
Email: [alina.stancu@concordia.ca](mailto:alina.stancu@concordia.ca)

**Office Hours:** The office hours will be announced in class at the beginning of the term and they will be posted on moodle. 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, Cambridge 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.**

**Summary:** 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; ellipsoids, John's Theorem.   |
| 4 - 7   | Convex functions; criteria of convexity for differentiable functions; inequalities for convex functions; conjugate functions; the Brunn-Minkowski theorems. |
| 8       | - <b>Midterm</b> -  |
| 9 - 10  | Polarity, duality and applications; symmetrizations of convex sets.   |
| 11 - 13 | Advanced convexity: mixed volumes and Minkowski's first and second inequalities.  |

**Grading: Homework (20%), Midterm (30%) and Final Exam (50%).**

**The evaluations of undergraduate students will be different in content than the evaluations of graduate students.**

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 Thursday, October 27, 2022 covering the material taught during the first six weeks of classes.**

**The final examination will cover material from the entire course.** All examinations are, for now, planned to be in person, but could be moved online if the university advises so.

It is our 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: <https://www.concordia.ca/conduct/academic-integrity.html>" [*Undergraduate Calendar, Sec 17.10.2*]

#### **Behaviour**

All individuals participating in courses are expected to be professional and constructive throughout the course, including in their communications.

Concordia students are subject to the [Code of Rights and Responsibilities](#) which applies both when students are physically and virtually engaged in any University activity, including classes, seminars, meetings, etc. Students engaged in University activities must respect this Code when engaging with any members of the Concordia community, including faculty, staff, and students, whether such interactions are verbal or in writing, face to face or online/virtual. Failing to comply with the Code may result in charges and sanctions, as outlined in the Code.

#### **Use of Zoom**

**Note: Zoom is included as an institutionally-approved technology. This means we have been assured of the privacy protections needed to use freely within the classroom.**

Zoom might be used in this course to facilitate learning at a distance. It may be used to record some or all of the lectures and/or other activities in this course. If you wish to ensure that your image is not recorded, speak to your instructor as soon as possible.

Also, please note that you may not share recordings of your classes and that the instructor will only share class recordings for the purpose of course delivery and development. Any other sharing may be in violation of the law and applicable University policies, and may be subject to penalties.

#### **Intellectual Property**

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](#). As specified in the [Policy on Intellectual Property](#), the University does not claim any ownership of or interest in any student IP. All university members retain copyright over their work.

#### **Extraordinary circumstances**

In the event of extraordinary circumstances and pursuant to the [Academic Regulations](#) the University may modify the delivery, content, structure, forum, location and/or evaluation scheme. In the event of such extraordinary circumstances, students will be informed of the change.