

# MATH\_V 542 201 2024W2 Harmonic Analysis II

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## Instructor: Professor I. Laba

- **Bio:** Ph.D. 1994 (University of Toronto). At UBC since 2000. Full Professor since 2005.
- **Contact information:** Math Bldg 200, ilaba@math.ubc.ca
- **Office hours:** by appointment. Normally, I will also be available to answer questions after each class.
- **Contact information:** For **general questions** about course material and homework, please use Piazza or Discussions on Canvas. For **individual and confidential matters** such as academic concession, please use Inbox -> Conversations on Canvas. Inquiries submitted on evenings and weekends will be answered on the next business day.

**Prerequisites:** MATH 420/507 and 404/541, or equivalent background in real and harmonic analysis.

**Course topics and learning objectives:** Harmonic analysis is an active and exciting area of research, with deep connections to many other areas of mathematics such as geometric measure theory, combinatorics, and number theory. This course will offer an introduction to some of today's hottest research questions and give you the tools to navigate the literature on the subject.

## Tentative schedule:

- Fractal sets and Hausdorff dimension (1 week)
- Fourier transforms of singular measures (1 week)
- The spherical maximal function (1 week)
- Kakeya sets (1-2 weeks)
- The restriction problem and the Tomas-Stein theorem (2 weeks)
- Restriction and Kakeya-based methods (1-2 weeks)
- Fourier dimension and Salem sets (1-2 weeks)
- Applications to projections and distance sets (2 weeks)
- Introduction to decoupling (if time allows)
- Student presentations (1-2 weeks)

This schedule may be adjusted as needed. I will post further updates and references on the Course Schedule page.

**Course structure:** 3 lecture hours per week, supplemented by homework, student presentations, and discussion boards on Canvas and Piazza. There will also be opportunities to ask questions during class.

**Required learning materials:** There is no required textbook for the course. You will be expected to take notes and/or consult source materials as indicated. Recommended textbooks are as follows.

- *Fourier Analysis*, J. Duoandikoetxea, American Mathematical Society, 2001

- *An Introduction to Harmonic Analysis*, Y. Katznelson, Cambridge University Press, 2004
- *Fourier Analysis: An Introduction*, E.M. Stein and R. Shakarchi, Princeton University Press, 2003
- *Real Analysis: Measure Theory, Integration, and Hilbert Spaces*, E.M. Stein and R. Shakarchi, Princeton Univ. Press, 2005
- *Lectures on Harmonic Analysis*, T. Wolff, American Mathematical Society, 2003. ([Full text available online](http://www.math.ubc.ca/~ilaba/wolff/notes_march2002.pdf) [\\_\(http://www.math.ubc.ca/~ilaba/wolff/notes\\_march2002.pdf\)](http://www.math.ubc.ca/~ilaba/wolff/notes_march2002.pdf)\_, with the publisher's permission.)

Reading suggestions for specific course topics will be posted as we go.

**Your course mark** will be based on homework (50%) and a presentation on a suitable topic chosen in consultation with the instructor (50%).

- **Homework:** there will be 3 assignments, tentatively due in late January, late February, and late March. Each one will be posted 2 weeks in advance, and the questions may include working out the details of arguments from class. Your homework score will be based on your 2 best homework scores; the lowest score will be dropped.
- **Topics for presentations will be posted here.**  
(<https://canvas.ubc.ca/courses/150788/pages/presentations>)

**Academic concession:** The rules and procedures for obtaining academic concession are governed by [UBC Policy V-135 on Academic Concession](http://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,329,0,0) (<http://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,329,0,0>). The presentation deadlines in this class will be flexible, so there should not be a problem with obtaining an extension for this if necessary. To account for minor illnesses and emergencies, our grading scheme allows for one homework assignment to be missed with no penalty. If you need to miss more than one assignment, please let me know so that we can discuss your circumstances.

**Academic misconduct:** UBC takes cheating incidents very seriously. After due investigation, students found guilty of cheating on tests and examinations are usually given a final grade of 0 in the course and suspended from UBC for one year. [See here for more information.](http://www.calendar.ubc.ca/vancouver/?tree=3,54,111,959)  
(<http://www.calendar.ubc.ca/vancouver/?tree=3,54,111,959>)


- While students are encouraged to study together, they should be aware that blatant copying of another student's work is a serious breach of academic integrity. You may use AI tools to improve your writing, but please be aware that such tools do not usually generate correct mathematical content. Your final write-up should be your own and you are responsible for the work you submit.
- Academic misconduct includes misrepresenting a medical excuse or other personal situation for the purposes of obtaining an academic concession.

**Weather Contingency Plan for Class Sessions:** Please check [ubc.ca](http://ubc.ca/) (<http://ubc.ca/>) often during bad weather or snow. If a class session is cancelled, the default contingency plan will be to have an online class on Zoom. For those who cannot attend an online class at short notice, a recording will be posted on Canvas. Please check Canvas for more information.

**[Statement about the University's values and policies, mandated by](#)****<http://www.calendar.ubc.ca/vancouver/?tree=3,54,111,959> **UBC Policy V-130****

**<http://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,328,0,0>**: UBC provides resources to support student learning and to maintain healthy lifestyles but recognizes that sometimes crises arise and so there are additional resources to access including those for survivors of sexual violence. UBC values respect for the person and ideas of all members of the academic community. Harassment and discrimination are not tolerated nor is suppression of academic freedom. UBC provides appropriate accommodation for students with disabilities and for religious, spiritual and cultural observances. UBC values academic honesty and students are expected to acknowledge the ideas generated by others and to uphold the highest academic standards in all of their actions. Details of the policies and how to access support are available **[here \(http://senate.ubc.ca/policies-resources-support-student-success\)](http://senate.ubc.ca/policies-resources-support-student-success)**.

## Course Summary:

Date	Details	Due
	 <b><u><a href="#">Presentation</a></u></b> <b><u><a href="https://canvas.ubc.ca/courses/150788/assignments/2033320">https://canvas.ubc.ca/courses/150788/assignments/2033320</a></u></b>	