Course Syllabus

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Section 101: MWF 1:00-1:50. Credit value: 3 credits.

Instructor: Professor I. Laba

- **Bio:** Ph.D. 1994 (University of Toronto). At UBC since 2000. Full Professor since 2005.
- **Email**: 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 300 and a score of 68% or higher in MATH 321, or equivalent background in real analysis.

Co-requisites: MATH 420/507.

Course 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:

- Learn the basic concepts of harmonic analysis on Euclidean spaces.
- Apply harmonic-analytic methods to questions in number theory, PDE and geometric measure theory.
- Practice formal mathematical proofs and high quality mathematical writing.

Course topics:

- Fourier series, their summability and convergence
  - Application: Weyl's equidistribution theorem.
- The Fourier transform on $\mathbf{R}^n$
  - The Schwartz space
  - Convolution and approximate identities
  - Fourier inversion and Plancherel's theorem
  - L^p spaces and the Hausdorff-Young formula
  - The uncertainty principle
  - The Poisson summation formula
- Real-variable theory and applications of Fourier analysis
  - Lebesgue density theorem

- The Hardy-Littlewood maximal function
- Spherical maximal operators, with applications to PDE theory
- Kakeya sets and Kakeya-type maximal operators (if time allows)

A more detailed tentative schedule of class topics and textbook sections covered each week **is posted here (https://canvas.ubc.ca/courses/181528/pages/course-topics-and-schedule)** . We may adjust the schedule and choice of optional topics depending on the background and interests of the participants.

Recommended textbooks:

- *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)** , with the publisher's permission.)

Course structure and learning activities:

- **Lectures, MWF 1-1:50:** Introduction to the material, with opportunities for questions and discussion.
- **Textbooks:** The recommended textbooks are listed above. Specific reading recommendations for each topic will be provided. Additionally, I will post lecture notes where available.
- **Homework:** there will be 5-6 assignments, tentatively every 2-3 weeks. Each one will be posted at least one week in advance, and the questions may include working out the details of arguments from class. Your lowest score will be dropped to allow for minor illnesses and other emergencies.
- **Discussion boards:** Both Piazza and Discussions on Canvas will be available.

Your course mark will be based on your homework assignments, weighed equally except that the lowest score will be dropped. There will be no final exam.

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)** . The details in this course are as follows.

- **Late or missed homework**: Late assignments will not be accepted, in order to discourage pile-ups of overdue work and allow the timely posting of solution sets for everyone. (If you cannot complete an assignment before the deadline for a valid reason, see below.)
- **To account for minor illnesses and emergencies,** the grading policy allows for one homework assignment to be missed with no penalty. Any academic concession requests involving two or more missed assignments should be discussed with me as soon as possible.
- Please note that academic concession for certain reasons, such as valid schedule conflicts that can be foreseen, must be requested in advance and may require additional documentation.

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)**

- While students are encouraged to study together, you 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 postponing an examination or quiz or otherwise obtaining an academic concession.

Additional resources for proof writing:

- **Richard Hammack, *Book of Proof* (https://www.people.vcu.edu/~rhammack/BookOfProof/)** : This textbook, available for free, is specifically dedicated to mathematical logic, proof techniques, and proof writing. It has been used in MATH 220 (the proof writing course) at UBC.
- **Francis Su's handouts on mathematical writing (https://math.hmc.edu/su/writing-math-well/)** include good examples and recommendations. Please don't treat these as strict rules that you have to follow 100% of the time. (Some level of informality is OK in homework assignments, for example you don't have to end *every* calculation with a punctuation sign. My posted lecture notes are a little bit informal. But this should give you a good idea of how you can make your mathematical writing clear and easy to understand.)

Weather Contingency Plan for Class Sessions: Please check **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 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)** .

Course Summary:

Date	Details	Due
Fri Oct 3, 2025	HW1 (https://canvas.ubc.ca/courses/181528/assignments/2211372)	due by 11:59pm
Wed Oct 29, 2025	HW2 (https://canvas.ubc.ca/courses/181528/assignments/2211373)	due by 11:59pm
Fri Nov 14, 2025	HW3 (https://canvas.ubc.ca/courses/181528/assignments/2211374)	due by 11:59pm