

# 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](mailto:ilaba@math.ubc.ca)
- **Online office hours (on Zoom):** Tuesdays 4-5, or by appointment.
- If you cannot attend regular office hours due to schedule conflict, you can request an appointment. Please make your request at least one day in advance. Our schedules can fill up, so that drop-ins and same-day requests for appointments can be difficult or impossible to accommodate.
- The best way to contact me is either by email or here on Canvas. Please note that email received on evenings and weekends will be answered on the next business day. (If you are not sure how to email a professor, [see here for templates and recommendations](#). (<http://www.math.ubc.ca/~ilaba/teaching/email.html>.)

**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-level learning objectives:**

- 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.

**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](#) [\\_ \(http://www.math.ubc.ca/~ilaba/wolff/notes\\_march2002.pdf\)](http://www.math.ubc.ca/~ilaba/wolff/notes_march2002.pdf)), with the

publisher's permission.)

### Required learning materials:

- **Homework assignments** (will be posted on Canvas)
- **Class notes** (will be posted on Canvas)

**Course topics:** Please note that the schedule and choice of optional topics may be adjusted depending on timing and on the background and interests of the participants.

- 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-type maximal operators (if time allows)

A more detailed tentative schedule of class topics and textbook sections covered each week [is posted here](#) and will be updated on a regular basis.

### Course structure and learning activities:

- **Textbooks:** The recommended textbooks are listed above. Specific reading recommendations for each topic will be provided.
- **Lectures, MWF 1-1:50:** the lectures will provide an introduction to the material (the main points, frequently asked questions, etc). Questions in class are encouraged and I will try to address them as we go. Class notes will be provided.
- **Homework** will be assigned biweekly. Each assignment will have only 2-4 questions, but that will include proofs, and you will have to include complete, correct, and clearly written explanations and justifications for your work. You will be graded both on the correctness of your mathematics and on the quality of your mathematical writing. The correct answer alone will **not** be sufficient.
- **Verification by Videoconferencing:** From time to time, I may ask selected students to explain their homework solutions to me, either live or via a recording, with the webcam on.

- **Discussion boards:** Both Piazza and Discussions on Canvas will be available.

**Your course mark** will be based on homework assignments (95%) and two engagement surveys (5%). The grades may be scaled at the end of the course. There will be no final exam.

- **Homework assignments:** Each assignment will be posted at least a week in advance. Your solutions are to be uploaded to Canvas and will be graded online. Late assignments will not be accepted. To allow for minor illnesses and other emergencies, the lowest homework score will be dropped with no questions asked.
- **Engagement surveys:** twice during the semester, tentatively in early October and again in November, I will ask you to answer 2-3 questions about your engagement in the course. I will use the results to fine-tune the course structure, and may follow up with you as needed. These will be worth 5% of your grade (2.5% for completing each one).

**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 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, keep the TA's work schedule consistent, 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. Academic concession requests involving two or more missed assignments should be accompanied by the [Department of Mathematics Academic Concession self-declaration form](http://www.math.ubc.ca/Ugrad/ugradForm/Student_Declaration_Academic_Concession_MATH.pdf) ([http://www.math.ubc.ca/Ugrad/ugradForm/Student\\_Declaration\\_Academic\\_Concession\\_MATH.pdf](http://www.math.ubc.ca/Ugrad/ugradForm/Student_Declaration_Academic_Concession_MATH.pdf)) and submitted as soon as reasonably possible. The Academic Concession form can be used for medical issues involving you or your family members, as well as other circumstances such as a "challenging emergency/unanticipated situation". I will be interpreting this liberally, and will only require a general description of the situation without personal detail (for example, you can say that you were sick without providing medical details). The usual remedy will be to have your course grade based on your remaining work.
- 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) (<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. Your final write-up should be your own.
- 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 help:

- **Online office hours:** Tuesdays 4-5 pm, starting on Sept. 14. Please use the Zoom tab here on Canvas. This is where you can come to ask questions or talk about anything related to this class. I will be available until 5 pm if needed, but please come before 4:30 so that we have sufficient time to address your questions.
- **Individual videoconferencing consultations by appointment** are available, on a limited basis, during normal business hours (M-F 9-5, Vancouver time). Please make your request at least one day in advance. Our schedules can fill up, so that drop-ins and same-day requests for appointments can be difficult or impossible to accommodate. Please also let me know in advance what you would like to discuss (e.g. the general nature of your inquiry, the homework or textbook question you'd like to talk about) so that I can look it up before the appointment and we can use the videoconferencing time efficiently.
- **The online Math Learning Center (MLC)** is a (virtual) space for undergraduate students to study math together, with friendly support from tutors, who are graduate students in the math department. More details will be provided when available.

### Additional resources for proof writing:

- **[Richard Hammack, \*Book of Proof\*](https://www.people.vcu.edu/~rhammack/BookOfProof/)** (<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/)** (<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.)

**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 \(http://senate.ubc.ca/policies-resources-support-student-success\)](http://senate.ubc.ca/policies-resources-support-student-success).