Mathematics 404/541 (Harmonic Analysis I)

Fall 2018

Instructor: Prof. I. Laba

- Math Bldg 200, (604) 822 4457, ilaba@math.ubc.ca

- Office hours (tentative): Mon 12-1, Wed 10-11, Thur 11-12, in MATH 200.
- The best way to contact the instructor is by email. Please note that email received on evenings a nd weekends will be answered on the next business day.
- If you cannot attend regular office hours due to schedule conflict, please make an appointment in advance. Drop-ins and same-day requests for appointments cannot always be accommodated.

Prerequisites: MATH 300 and a score of 68% of MATH 321. **Corequisites:** MATH 420.

Your course grade will be based on 6 problem sets, tentatively due on September 20, October 4, October 18, November 1, November 15 and November 29. To allow for minor absences and short illnesses, the lowest score will be dropped; each of the remaining 5 problem sets will be worth 20% of your grade. There will be no final exam. Grades may be scaled at the end.

Academic concession: Normally, late homework will not be accepted. Since the lowest homework score does not count towards your grade, you can miss one assignment with no penalty or explanation. Additional exceptions may be granted with prior consent of the instructor or for **documented** medical reasons.

This course will provide an introduction to harmonic analysis on Euclidean spaces, with applications to number theory, PDE and geometric measure theory.

Tentative topics are as follows. Please note that parts of the course may be adjusted depending on timing and on the background and interests of the participants.

- Fourier series
  - Summability and convergence
  - Application: Weyl's equidistribution theorem.
- Some basic notions of real-variable theory
  - Lebesgue density theorem
  - The Hardy-Littlewood maximal function
  - Convolution and approximate identities
  - Interpolation
- The Fourier transform on $\mathbf{R}^n$
  - The Schwartz space
  - Fourier inversion and Plancherel's theorem
  - L^p spaces and the Hausdorff-Young formula
  - The Poisson summation formula
- Distributions
  - Tempered distributions
  - Fourier transform of distributions
  - Fourier transform of singular measures
- Applications of Fourier analysis
  - Applications to PDE theory
  - The uncertainty principle
  - The stationary phase method
  - Counting lattice points in large discs
- Introduction to the Hilbert transform

- The Riesz and Kolmogorov theorems
- L^p convergence of the Fourier transform: an introduction

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, with the publisher's permission.)

Please read the UBC policy on Student Conduct and Discipline.

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