Introduction to Harmonic Analysis - Math 541
Spring 2016

- *Instructor: Malabika Pramanik*
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- *Office hours: To be announced.*

- **Web page:** The course website is

  http://www.math.ubc.ca/~malabika/teaching/ubc/spring16/math541/index.html

Homework assignments and all relevant course information (such as changes to office hours if any, or solutions to homework problems if needed) will be posted here.

- **Text:** There are no required textbooks. The following textbooks are recommended.
- *Lectures on Harmonic Analysis (2003), by T.H. Wolff*, AMS, ISBN: 978-0-8218-3449-7.
- *An Introduction to Harmonic Analysis (3rd edition), by Y. Katznelson*, Cambridge, ISBN: 978-0-521-54359-2.
- *Singular Integrals and Differentiability Properties of Functions (1970), by E. Stein*, Princeton University Press, ISBN: 0-691-08079-8.
- *Introduction to Fourier Analysis on Euclidean Spaces (1971), by E. Stein, and G. Weiss*, Princeton University Press, ISBN: 0-691-08078-X.
- *Harmonic Analysis: Real-variable Methods, Orthogonality and Oscillatory Integrals (1993), by E. Stein*, Princeton University Press, ISBN: 0-691-03216-5.
- *Classical and Modern Fourier Analysis, by L. Grafakos.*

- **Course outline :** The cope topics of the course are the following:
1. *Basic material concerning Fourier series, Fourier transform and Fourier inversion*

   - Fourier basis for $L^2(\mathbb{T})$
   - Convolution
   - Approximate identities
   - Temperate distributions
   - Some applications

2. *Convergence of Fourier series*

   - Decay of Fourier coefficients
   - Uniform convergence of Fourier series

  – Pointwise convergence and almost everywhere divergence
  – Norm convergence

3. *Interpolation of operators*

  – Complex methods (Riesz-Thörin theorem, analytic interpolation)
  – Real methods (Marcinkiewicz interpolation theorem)
  – Applications (Hausdorff-Young inequality, Young's convolution inequality, fractional integration, Hardy-Littlewood maximal theorem).

4. *Singular integral operators*

  – Calderón-Zygmund kernels
  – Some multiplier operators
  – The Calderón-Zygmund decomposition
  – L^p boundedness of Calderón-Zygmund singular integral operators
  – Homogeneous distributions, Hilbert transform, Riesz transform.

5. *Littlewood-Paley theory*

  – Almost orthogonality in Hilbert spaces, Cotlar-Knapp-Stein lemma
  – A square function that characterizes L^p
  – Variations and applications

Time permitting, we will also consider other special topics.

• **Lectures :** Monday, Wednesday, Friday 10 am - 11 am in Mathematics Annex 1118.

• **Grading Policy :** To be announced after the first week.