

**EXAM SYLLABUS FOR
V4B5: REAL AND HARMONIC ANALYSIS
(JULY 25, 2016 IN OFFICE 3.012)**

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Part 1. Basic theory. Students should be ready to answer questions related to *all* of the following topics:

- Basic tools: Hölder’s and Minkowski’s inequalities, the dual of L^p , convolution, good kernels and approximations to the identity, interpolation theorems (Riesz–Thorin, Marcinkiewicz and Stein).
- Hilbert transform (including proof of the L^p estimates).
- Hardy–Littlewood maximal function (including proof of the weak-type (1,1) estimate).
- Fourier transform on the Schwartz space, on L^1 and on L^2 (including proof of Plancherel’s theorem).
- Distribution theory: space of tempered distributions, Fourier transform, $\text{pv}(\frac{1}{x})$, and homogeneous distributions.
- Calderón–Zygmund theory (including proof of the L^p estimates).
- Oscillatory integrals: principle of non-stationary phase, van der Corput’s lemma, stationary phase in all dimensions (with proofs).

Part 2. Advanced topics. Students should choose *one* topic from the following list, and be ready to present it and answer related questions:

- Sharp Hausdorff–Young inequality
- Sharp Hardy–Littlewood–Sobolev inequality
- Averaging operators
- Fourier restriction theory
- Sharp Tomas–Stein inequality on \mathbb{S}^2

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