Applications of Analysis in Physics (L16)

Non-Examinable (Graduate Level)

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This course is aimed at students who are studying physics and are interested in learning some of the more advanced analysis that underpins much of modern theoretical physics. We will emphasise widely applicable concepts and avoid technical details of proofs, while signposting where students can find them. We will aim to cover:

- Background: Hilbert and Banach spaces; distributions; Fourier transform and Sobolev spaces.
- Compactness: spectra of self-adjoint compact operators; the direct method of the calculus of variations.
- PDEs on manifolds: Laplace/wave equation on a Riemannian/Lorentzian manifold.
- Topology and PDEs: index theorems, heat trace.

Pre-requisites

We assume some basic background analysis knowledge: roughly second year undergraduate level. We also assume some differential geometry at a level similar to that of the GR course.

Literature

1. M. Reed, B. Simon, *Methods of Mathematical Physics Vols. 1, 2*. Elsevier, 1981.
2. S. Rosenberg, *The Laplacian on a Riemannian Manifold*. CUP 1997.

Additional support

Problems will be set, and there will be an opportunity to discuss these with the lecturer.