

LTCC Advanced Course: Spectral Geometry

Basic Details:

- Core Audience: 2nd/3rd yr students in pure mathematics
- Course Format: **Extended**: 5 x 2hr lectures

Course Description:

- **Overview:** Spectral geometry studies the interplay between the geometry of an object and the eigenvalues of an operator acting on functions on that object. The field is often introduced with Mark Kac's question, "Can one hear the shape of a drum?" We focus on the Laplace operator in two dimensions.
- **Keywords:** spectral geometry, Laplace operator, Rayleigh quotient, isoperimetric inequalities, heat invariants, isospectrality
- **Syllabus:**
 1. Definitions, preliminaries, and basic examples
 2. Variational principles and applications (domain monotonicity, Weyl's law)
 3. Geometric eigenvalue inequalities
 4. Heat equation, spectral invariants, and isospectrality
- **Relevant textbooks:** Eigenvalues in Riemannian Geometry by Isaac Chavel; Topics in Spectral Geometry by Michael Levitin, Dan Mangoubi, and Iosif Polterovich (free preliminary version available at <https://michaellevitin.net/Book/TSG230529.pdf>)
- **Prerequisites:** Familiarity with the introductory ideas of Riemannian geometry (see Chapter 4 of Spectral theory and geometry by F. E. Burstall, editors E. B. Davies and Yu. Safarov, [doi:10.1017/CBO9780511566165.00](https://doi.org/10.1017/CBO9780511566165.00), for the most relevant concepts, or consult Chapters 0 and 1 of Riemannian Geometry by Manfredo Perdigão do Carmo); some knowledge of PDEs and functional analysis

Format:

- I will share my notes for the course, and will indicate the relevant sections of the two textbooks above for further reading.
- There will be exercises given during and after each lecture.

Lecturer Details:

- Lecturer: Emily Dryden
- Lecturer home institution: King's College London and Bucknell University
- Lecturer e-mail: ed012@bucknell.edu