

# LTCC Advanced Course

**Course Title:** Black Holes

## **Basic Details:**

- Core Audience: Applied and pure mathematics students with some knowledge of general relativity (e.g., from the LTCC course “Mathematical Topics of General Relativity” or any introductory course on the subject that covers the field equations and the Schwarzschild metric).
- Course Format: 5 x 2 hours lectures.

## **Course Description:**

Overview: This course will cover some mathematical aspects of black holes and it will be a good introduction to some key ideas in advanced general relativity such as the Newman-Penrose formalism and various approximation methods.

Keywords: Black holes, general relativity, Kerr spacetime, Newman-Penrose formalism, geodesics.

## Syllabus:

The content taught each week will be

1. Introductory material and overview. Review of the Schwarzschild metric. Introduction to the Kerr metric.
2. The geodesic structure of the Kerr spacetime.
3. Singularities and causal structure.
4. The Weyl tensor. Tetrads. Newman-Penrose formalism.
5. Approximation methods.

## Recommended Reading:

1. S. Chandrasekhar. The mathematical theory of black holes. *The Clarendon Press, Oxford University Press, New York, 1998.*
2. B. O’Neill. The geometry of Kerr black holes. *A K Peters, Ltd., Wellesley, MA, 1995.*
3. P. T. Chruściel. Geometry of black holes. OUP 2020.

**Format:** Printed lecture notes/slides will be available. Five problem sheets will be provided, with full worked solutions made available at the end of the course.

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