

## METRIC SPACES (MATH3961)

Lecturer: L. Paunescu  
Office: Carslaw 721  
Office Hours: Monday 2pm-3pm or by arrangement.  
tel 9351-2969  
e-mail: laurentiu.paunescu@sydney.edu.au

Syllabus: The first 9 weeks shall be an introduction to topology, with an emphasis on metric spaces. This is the basis for modern analysis on the one hand, and for the classification of geometrically interesting spaces (such as  $n$ -dimensional manifolds) on the other. It is a prerequisite for the PM4 Core courses "Algebraic Topology" and "Functional Analysis" and is an essential part of a rounded mathematical education.

The syllabus for the first six weeks was drafted by Drs Daners and Paunescu in 2005, and corresponds roughly to the following chapters of Dr Choo's notes:

Week 1 - Chapters 1 and 2  
Week 2 - Chapters 3 and 4 (and 12)  
Week 3 - Chapters 5 and 6  
Week 4 - Chapters 7 and 8  
Week 5 - Chapter 11  
Week 6 - Chapters 9 and 10

In week 7 we consider the Heine-Borel, Weierstraß and Baire Theorems.

In weeks 8 and 9 we shall consider the notions of "separable" spaces and "separation properties", respectively. (Although "separable" and "separation" are closely related words, they have quite distinct uses here).

Weeks 10-12 shall consider applications to Hilbert spaces and Fourier theory, and in Week 13 (the final week) we shall look at discrete dynamical systems.

I shall try to stay close to the syllabus. However my emphases and choices of examples may diverge from those in the text, and the above timeline may vary somewhat. In particular, I want to include some material on product spaces.

There are three **lectures** a week plus a **tutorial**, which is an essential part of the course.

**Keywords:** Metric, topology, complete, homeomorphism, connected, compact, Baire category, separable, separation properties.

Inner product, CBS inequality, orthonormal bases, Fourier series, orthonormal families of functions.

Iterations, Cantor sets, dynamical systems, chaos.

**Text:** *Lecture Notes on Metric Spaces* (notes for MATH3961) by K.G. Choo

**References** on closed reserve in Library:

*Basic Topology* by M.A. Armstrong

*Topology* by K. Jänich

*Introduction to Modern Analysis and Topology* by G.F. Simmons

**Assessment:** 2 assignments (due: 27 April, 29 May).

Assignment total: 20%,

Final Exam: 80%