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MATH20122

Metric Spaces

Unit code:	MATH20122
Credit Rating:	10
Unit level:	Level 2
Teaching period(s):	Semester 2
Offered by	School of Mathematics
Available as a free choice unit?:	N

Requisites

None

Aims

The course unit aims to introduce the basic ideas of metric spaces.

Overview

A metric space is a set together with a good definition of the distance between each pair of points in the set. Metric spaces occur naturally in many parts of mathematics, including geometry, fractal geometry, topology, functional analysis and number theory. This lecture course will present the basic ideas of the theory, and illustrate them with a wealth of examples and applications.

This course unit is strongly recommended to all students who intend to study pure mathematics and is relevant to all course units involving advanced calculus or topology.

Assessment methods

- Other - 20%

- Written exam - 80%

Assessment Further Information

- Coursework; Weighting within unit 20%
- 2 hours end of semester examination; Weighting within unit 80%

Learning outcomes

On completion of this unit successful students will be able to:

deal with various examples of metric spaces;

have some familiarity with continuous maps;

work with compact sets in Euclidean space;

work with completeness;

apply the ideas of metric spaces to other areas of mathematics.

Syllabus

1. Basic Definitions. Euclidean metric, taxicab metric, discrete metric, edge metric, word metric, sup metric, L1 metric, Hausdorff metric, l2 metric, product metrics. Examples. [4 lectures]

2. Open and Closed Sets. Interior, closure, sequences and convergence, frontier. Denseness. Equivalent metrics. Examples. [4]

3. Uniform Convergence. Sequences of continuous functions. Examples. [2]

4. Continuous maps. Extending the elementary definition. Relationship with open sets, sequences. Examples [4]

5. Compactness. Open coverings. Continuous maps on compact sets. Compactness in Euclidean space. [4]

6. Completeness. Cauchy sequences. The Contraction Mapping Theorem, Examples. [3]

Recommended reading

Two books are particularly relevant. The first is

Wilson A. Sutherland, Introduction to Metric and Topological Spaces, Oxford University Press (Second Edition) 2009

which contains almost all the material in the course, is beautifully written, and is highly recommended. Copies are available to purchase in Blackwells, and to borrow from the JRUL. For an alternative view, try

Micheal O'Searcoid, *Metric Spaces*, Springer 2006.

Feedback methods

Tutorials will provide a place for student worked examples to be marked and discussed providing feedback on performance and understanding. Feedback is also provided via return of marked coursework.

Study hours

- Lectures - 22 hours
- Tutorials - 11 hours
- Independent study hours - 67 hours

Teaching staff

Nigel Ray - Unit coordinator