MAST30026 Metric and Hilbert Spaces

Credit Points:	12.50
Level:	3 (Undergraduate)
Dates & Locations:	2010, Parkville This subject commences in the following study period/s: Semester 2, Parkville - Taught on campus. Lectures and practice classes.
Time Commitment:	Contact Hours: 3 x one hour lectures per week, 1 x one hour practice class per week Total Time Commitment: Estimated total time commitment of 120 hours

Prerequisites:	One of
	
	   # **620-297 Group Theory and Linear Algebra (/view/2010/620-297)**
	   # 620-222 Linear and Abstract Algebra (prior to 2009)
	
	and one of
	
	   # **620-295 Real Analysis with Applications (/view/2010/620-295)**
	   # **620-158 Accelerated Mathematics 2 (/view/2010/620-158)**

Corequisites:	None
Recommended Background Knowledge:	None

Non Allowed Subjects:	Students who have completed either of the following may not enrol in this subject for credit.
	
	   # 620-311 Metric Spaces (prior to 2010)
	   # 620-312 Linear Analysis (prior to 2010)

Core Participation Requirements:	It is University policy to take all reasonable steps to minimise the impact of disability upon academic study and reasonable steps will be made to enhance a student's participation in the University's programs. Students who feel their disability may impact upon their active and safe participation in a subject are encouraged to discuss this with the relevant subject coordinator and the Disability Liaison Unit.
Coordinator:	Prof Joachim Rubinstein
Contact:	Third Year Coordinator **Email: tycoord@ms.unimelb.edu.au (mailto:tycoord@ms.unimelb.edu.au)**
Subject Overview:	This subject provides a basis for further studies in modern analysis, geometry, topology, differential equations and quantum mechanics. It introduces the idea of a metric space with a general distance function, and the resulting concepts of convergence, continuity, completeness, compactness and connectedness. The subject also introduces Hilbert spaces: infinite dimensional vector spaces (typically function spaces) equipped with an inner product that allows geometric ideas to be used to study these spaces and linear maps between them. Topics include: metric and normed spaces, limits of sequences, open and closed sets, continuity, topological properties, compactness, connectedness; Cauchy sequences, completeness, contraction mapping theorem; Hilbert spaces, orthonormal systems, bounded linear operators and functionals, applications.

Objectives:	On completion of this subject, students should understand:
	
	   # the definition and fundamental properties of metric spaces, including the ideas of convergence, continuity, completeness, compactness and connectedness;
	   # the definition and fundamental properties of Hilbert spaces, and bounded linear maps between them;

	# how basic concepts of geometry and linear algebra can be generalised to infinite dimensional spaces; and should be able to: # prove simple results about metric spaces and Hilbert spaces; # analyse bounded linear maps between Hilbert spaces; # apply general results on metric and Hilbert spaces to solve problems in other areas of mathematics and physics, including numerical methods and differential equations.
Assessment:	Two or three written assignments due at regular intervals during semester amounting to a total of up to 50 pages (20%), and a 3-hour written examination in the examination period (80%).
Prescribed Texts:	None
Recommended Texts:	J. J. Koliha, Metrics, Norms and Integrals: An introduction to Contemporary Analysis, World Scientific, 2008 L. Debnath and P. Mikusinski, Introduction to Hilbert Spaces with Applications, 2nd Ed, Academic Press, 1999 E. Kreyszig, Introductory Functional Analysis with Applications, Wiley, 1989
Breadth Options:	This subject potentially can be taken as a breadth subject component for the following courses: # **Bachelor of Commerce (https://handbook.unimelb.edu.au/view/2010/B-COM)** # **Bachelor of Environments (https://handbook.unimelb.edu.au/view/2010/B-ENVS)** # **Bachelor of Music (https://handbook.unimelb.edu.au/view/2010/B-MUS)** You should visit **learn more about breadth subjects (http://breadth.unimelb.edu.au/ breadth/info/index.html)** and read the breadth requirements for your degree, and should discuss your choice with your student adviser, before deciding on your subjects.
Fees Information:	Subject EFTSL, Level, Discipline & Census Date, http://enrolment.unimelb.edu.au/fees
Generic Skills:	In addition to learning specific skills that will assist students in their future careers in science, they will have the opportunity to develop generic skills that will assist them in any future career path. These include: # problem-solving skills: the ability to engage with unfamiliar problems and identify relevant solution strategies; # analytical skills: the ability to construct and express logical arguments and to work in abstract or general terms to increase the clarity and efficiency of analysis; # collaborative skills: the ability to work in a team; # time-management skills: the ability to meet regular deadlines while balancing competing commitments.
Notes:	This subject is available for science credit to students enrolled in the BSc (both pre-2008 and new degrees), BASc or a combined BSc course.
Related Course(s):	Bachelor of Science
Related Majors/Minors/ Specialisations:	Mathematical Physics Mathematics and Statistics (Mathematical Physics specialisation) Mathematics and Statistics (Pure Mathematics specialisation) Pure Mathematics