Subject Information Guide

Topology and Dynamics MAT4TD

Semester 2, 2014

Administration and contact details

Host Department	Department of Mathematics and Statistics
Host Institution	La Trobe University
Name of lecturer	John Banks
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Subject details

Handbook entry URL (sorry, but it doesn't seem to work if you reduce it!)	http://www.latrobe.edu.au/udb_public/publicview$p_subjects.queryview?P_SUBJECT_CODE=MAT4TD&P_SUBJECT_OFFER_YEAR=2014&Z_CHK=47991&P_SUBJECT_CODE_1=MAT4TD&P_SUBJECT_NAME=&P_SEMESTER=&P_UNIT_CLASS=&P_YEAR_LEVEL=&P_FACULTY=&P_CAMPUS=&P_DISCIPLINE_CODE=&P_SUBJECT_OFFER_YEAR_1=2014&Z_START=&Z_ACTION=NEXT
Subject homepage URL	Accessed Via LMS: https://lms.latrobe.edu.au/login/index.php
Honours student hand-out URL	Will appear on LMS (see above)
Start date:	28 July 2014
End date:	24 October 2014
Contact hours per week:	2
Lecture day and time:	Tuesdays 11AM to 1PM.
Description of electronic access arrangements for students (for example, WebCT)	LMS Access (Moodle) will be provided. Email. We will use tablet or electronic whiteboard for student presentations.

Subject content

1. Subject content description

We develop some definitions and results of very general application in *point set topology* and use them to explore the theory of (discrete time) *topological dynamics*. This will include an exploration of *chaos* and related dynamical properties. The point set topology is developed simultaneously with the topological dynamics and applications of the topology to the dynamics being added progressively as we proceed. There will be a strong focus on *symbolic dynamics* where we represent the state of a dynamical system as an infinite string of symbols drawn from a finite alphabet. In this context, we will see the connection between dynamical systems and the theory of *formal languages* that underpins much of theoretical computer science.

2. Week-by-week topic overview

The following may be subject to change depending on student interests.

Week	Topological topics	Dynamical topics
1	Bases, Sub-bases , Countability.	Intro to discrete time dynamical systems.
2	Closure, Interior, Boundary	Orbits, Periodic points.
3	Limits, Continuity, Homeomorphisms.	Invariant sets, Conjugacy.
4	Separation Properties, Metric Spaces.	Sensitive dependence.
5	Compactness and related concepts.	Attractors and repellors, Bifurcations.
6	Baire spaces.	Transitivity and related concepts, Chaos.
7	Connectedness and related concepts.	Dynamics of one-dimensional maps.
8	Finite products, Topological groups.	Group rotations.
9	Countable products.	Symbolic dynamics and languages.
10	General products, Tychonoff's Theorem	Shifts of finite type and Sofic shifts.
11	Student presentations of mini-projects.	Sofic shifts.
12	Student presentations of mini-projects.	Inverse limit spaces.

3. Assumed prerequisite knowledge and capabilities

- It is assumed students have already encountered the theory of point set topology and metric spaces including general definitions of:
    - Open, closed and dense sets and the closure of a set,
    - Continuity and convergence,
    - Hausdorff spaces,
    - Connectedness and path connectedness,
    - Compactness,
    - Basis for a topological space,
    - Finite product of topological spaces.

  and the standard theorems relating these concepts to one another.

- Although some previous experience of these ideas is assumed, they will be revised as further definitions and results in point set topology are gradually introduced.
- No previous study of dynamics is assumed.

4. Learning outcomes and objectives

AQF Program Learning Outcomes addressed in this subject	**Associated AQF Learning Outcome Descriptors for this subject**
Understands the key concepts in point set topology and how they may be applied to the characterisation and analysis of dynamical behaviour.	K1
Can develop and present clear succinct written arguments in the fields of point set topology and topological dynamics.	S1, S2, S3, S5
Can construct advanced level proofs in mathematics.	S1, S3, S5
Can independently read advanced technical material and use it to produce a well-structured and well-presented exegesis.	A4

Learning Outcome Descriptors at AQF Level 8

Knowledge

K1: coherent and advanced knowledge of the underlying principles and concepts in one or more disciplines

K2: knowledge of research principles and methods

Skills

S1: cognitive skills to review, analyse, consolidate and synthesise knowledge to identify and provide solutions to complex problem with intellectual independence

S2: cognitive and technical skills to demonstrate a broad understanding of a body of knowledge and theoretical concepts with advanced understanding in some areas

S3: cognitive skills to exercise critical thinking and judgement in developing new understanding

S4: technical skills to design and use in a research project

S5: communication skills to present clear and coherent exposition of knowledge and ideas to a variety of audiences

Application of Knowledge and Skills

A1: with initiative and judgement in professional practice and/or scholarship

A2: to adapt knowledge and skills in diverse contexts

A3: with responsibility and accountability for own learning and practice and in collaboration with others within broad parameters

A4: to plan and execute project work and/or a piece of research and scholarship with some independence

5. Learning resources

- Comprehensive subject text *MAT4TD Topology and Dynamics* will be provided on-line (and as hard copy if requested).
- There are no mandatory software requirements, but access to LATeX is desirable for the mini-project (see below).
- Some kind of electronic whiteboard or tablet will be needed for student presentations.

6. Assessment

Exam/assignment/classwork breakdown					
Exam	0 %	**Assignment**	100 %	**Class work**	0 %
Assignment due dates		28 August (Assignment 1)	25 September (Assignment 2)	31 October (mini-project).	
Approximate exam date:				N.A.	

Explanation of Mini-Project: Each student will pick a individual project from a list of project descriptions. Each project description lists key results you need to prove. These results typically rely on several other results and you are required to prove all of these underlying results as well, except those you are told you may assume. The mini-project is *not* intended to be research project, but rather as practice at writing up a body of connected results in a coherent way (eg, Lemma, Remark, explanation, Theorem, Example etc.) There are exercises in the subject text to assist you to complete all of the required proofs, so much of the work will be in deciding *what you need to prove* and then *finding the exercise* that guides you through the proof.

7. Institution Honours program details

Weight of subject in total honours assessment at host department	12.5%
Thesis/subject split at host department	Thesis = 37.5%, Subjects = 62.5%
Honours grade ranges at host department:	
H1	80-100 %
H2a	70-80 %
H2b	60-70 %
H3	50-60 %