M2PM5 METRIC SPACES AND TOPOLOGY
TIMETABLE AND OUTLINE

PROF. TOM COATES

1. Lectures and Problem Classes

- Lectures:
    - Tuesdays, 11am–1pm in 130 Huxley;
    - Wednesdays, 11am–noon in 130 Huxley;
- Problem classes:
    - Thursdays, 1pm–2pm in 130 Huxley.

First lecture: Tuesday 17th January 2017, 11am in 130 Huxley.
First problem session: Thursday 26th January 2017, 1pm in 130 Huxley.

2. Contact Details, Office Hours, Course Webpage, etc.

- My contact details:
    - Office: 662 Huxley Building
    - Email: t.coates@imperial.ac.uk
- Office hours:
    - Wednesdays at noon in 662 Huxley
- Course webpage:
    - http://coates.ma.ic.ac.uk/M2PM5/
    - short link: http://bit.ly/M2PM5

    Notes, problem sheets, announcements, etc. will appear here.
- Twitter feed:
    - @ImperialGeom

    I will Tweet course announcements, links to course materials, etc.

3. Textbook

Main reference:

- *Introduction to Metric and Topological Spaces* by W. A. Sutherland,
  Second Edition (OUP; paperback). We will use this a lot.
  Several copies are available in the College Library.
  Supplementary material available on-line at: http://bit.ly/M2PM5-book

Another reference:

- *Algebraic Topology* by A. Hatcher, CUP, 2002.
  We will use this only a little, at the end of the course.
  The entire text is available on-line, for free, at:
  http://www.math.cornell.edu/~hatcher/AT/ATpage.html.

4. Examination

- 90% of your grade will be determined by a 2-hour closed-book examination in May or June (date and time TBA);
- 10% of your grade will be determined by 2 assessed courseworks (5% each), to be handed in by 2pm on respectively Wednesday 8th February 2017 and Wednesday 8th March 2017.

5. Schedule

A tentative outline of the material that we will cover is as follows. This may change as the term progresses; if so then an updated outline will be given during lectures.

- Lectures 1–6 (17th–25th January 2017).
  Metric spaces:
  - definition, examples including function spaces
  - continuity
  - boundedness
  - subspaces
  - open and closed subsets, continuity in terms of open sets
  - equivalence of metrics
- Lectures 7–13 (31st January–14th February 2017).
  Topological spaces:
  - definition, examples
  - finer and coarser topologies
  - continuity
  - bases
  - subspaces
  - homeomorphisms
  - neighbourhoods, closed sets, limit points, the closure of a set
  - dense sets
- Lecture 14 (14th February 2017).
  The Hausdorff property.
- Lectures 15–18 (15th–22nd February 2017).
  Compactness:
  - compact subsets of metric spaces
  - compact subsets of Hausdorff spaces
  - compactness is a topological property
  - the Heine–Borel Theorem
- Lectures 19–20 (28th February 2017).
  Sequential compactness:
  - convergent sequences and Cauchy sequences
  - the Bolzano–Weierstrass Theorem
  - Lebesgue number
- Lectures 21–24 (1st–8th March 2017).
  Complete metric spaces:
  - completeness
  - total boundedness
  - convergence in function spaces: pointwise and uniform convergence
  - the Cauchy Criterion
  - the Contraction Mapping Theorem (*aka* Banach's Fixed Point Theorem)
- Lectures 25–30 (14th–23rd March 2017).
  The Fundamental Group:
  - paths and homotopies
  - definition of the fundamental group
  - the fundamental group of the circle; winding number
  - application: the Fundamental Theorem of Algebra