

Welcome to SMSTC!

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SMSTC Director

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What is SMSTC?

SMSTC is the Scottish Mathematical Sciences Training Centre.

We provide graduate mathematics courses to all of Scotland.

There are eight member departments.



Why do we exist?

UK higher education in mathematics is traditionally

- **short** (typically 3 years UG + 1 year Masters + 3 years PhD);
- **narrow** (graduate study was highly specialised).

The 2004 International Review of UK Mathematics concluded that PhD graduates were often strong in their narrow field, but lacked breadth.

As a result:

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As a result:

- the standard PhD programme was **lengthened** to 3.5 years,
- with the first 0.5 years to be spent on **broadening** training.

This training is provided by six 'taught course centres' across the UK.

Who are we?

SMSTC is a community project. It includes:

- **Students:** mostly 1st year maths PhD, but also higher years, other subjects, other universities, postdocs, staff, . . .
- **Lecturers:** c. 50 per year, drawn from all eight universities.
- **Administrator:** Liam Holligan (ICMS).
- **Director:** Fraser Daly.
- **Theme Heads:** Victor Elvira, Michael Grinfeld, Ana Lecuona, Richard Scott.
- **Technical staff** at each university.
- **Postgraduate co-ordinators** at each university.
- **Tutors** at each university.
- **External advisers** from outwith Scotland.
- **Student reps** at each university (**volunteers needed!**)

What courses do we offer?

We run **core modules** and **supplementary modules**.

Core modules:

- run every year;
- are aimed mostly at first-year PhD students;
- consist of two-hour lectures once a week for ten weeks;
- have graded assignments.

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Supplementary modules:

- are different every year;
- may be more advanced and taken by higher-year PhD students;
- may be shorter;
- don't always have graded assignments.

If you want a supplementary module to count towards your department's training requirements, talk to your supervisor or PG coordinator.

Themes

You can take any combination of modules you want, as long as:

- you have suitable prior knowledge (see the Prospectus);
- your department agrees.

For convenience, we organize the core modules into four themes:

- Analysis
- Applications of Mathematics
- Probability & Statistics
- Structure & Symmetry

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Analysis

Theme Head: Michael Grinfeld (Strathclyde)

Core modules:

- Dynamical Systems and Conservation Laws (Semester 1)
- Measure and Integration (Semester 1)
- Elliptic and Parabolic PDEs (Semester 2)
- Functional Analysis (Semester 2)

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Applications of Mathematics

Theme Head: Richard Scott (St Andrews)

Core modules:

- Asymptotic and Analytical Methods (Semester 1)
- Continuum Mechanics (Semester 1)
- Numerical Methods (Semester 2)
- Mathematical Biology and Physiology (Semester 2)

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Probability and Statistics

Theme Head: Victor Elvira (Edinburgh)

Core modules:

- Foundations of Probability (Semester 1)
- Regression and Simulation Methods (Semester 1)
- Stochastic Processes (Semester 2)
- Modern Regression and Bayesian Methods (Semester 2)

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Structure and Symmetry

Theme Head: Ana Lecuona (Glasgow)

Core modules:

- Groups, Rings and modules (Semester 1)
- Algebraic Topology (Semester 1)
- Algebras and Representation Theory (Semester 2)
- Manifolds (Semester 2)

Supplementary modules 2022-23

First semester:

- Ethics in Mathematics
- Quantum Computing
- Geometry of Gauge Fields
- Infinite Dimensional Dynamics

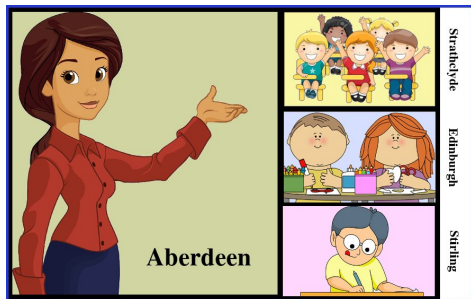
Second semester:

- Classical and Quantum Integrable Systems
- Homological Algebra

How do lectures work?

Lectures are delivered by Zoom. They can be joined from your home/office, but we encourage you to gather at your local videoconferencing room if possible: see the SMSTC website or your PG coordinator for details.

Example: If you're in Dundee and the lecturer is in Aberdeen, you see this:



Screen 1

The definition

A metric space X is **positive definite** if for every finite $A \subseteq X$, the matrix Z_A is positive definite.

E.g.: \mathbb{R}^n with the Euclidean or taxicab metric, hyperbolic space, any ultrametric space.

Theorem (Meckes)

All sensible ways of extending the definition of magnitude from finite metric spaces to compact positive definite spaces are equivalent.

E.g.: For a compact positive definite space A , we can define

$$|A| = \sup\{|B| : \text{finite } B \subseteq A\}.$$

Or equivalently, we can choose a sequence (B_n) of finite subsets with $B_n \rightarrow A$ in the Hausdorff metric, then define $|A| = \lim_{n \rightarrow \infty} |B_n|$.

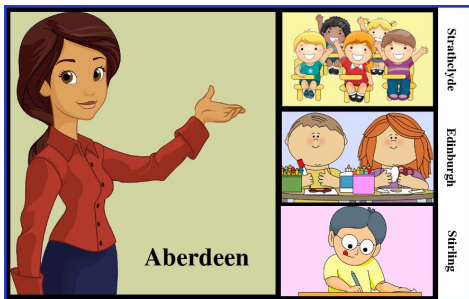
The definition can also be expressed directly, without using finite approximations.

Screen 2

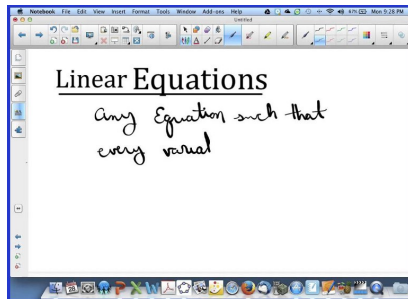
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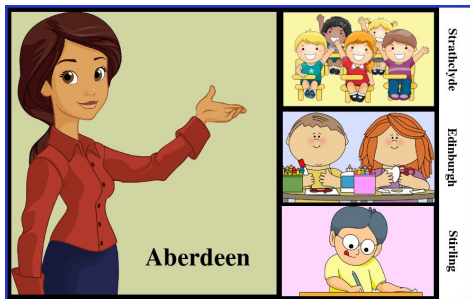


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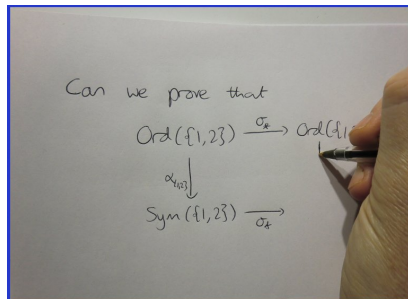
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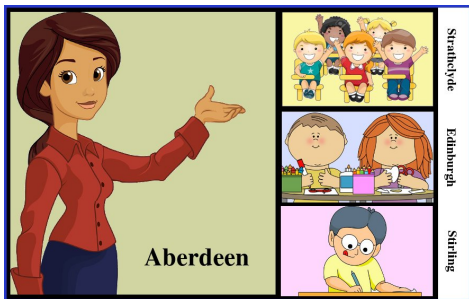


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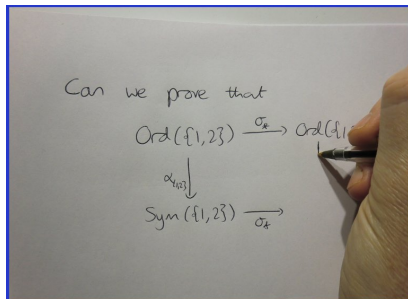
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Screen 1



Screen 2

It's interactive: you can ask and answer questions. (But please keep the microphone off otherwise!)

How do lectures work?

Lectures will be delivered via Zoom.

- Joining details will be emailed to enrolled students. Please don't share them further.
- Lectures will not (and must not) be recorded — exceptions by request to the Director only.
- Full notes are available on the website.
- It's up to you if you want video on/off and if you want to participate — but if you can participate, this should benefit you.

What happens outside lectures?

Material on the website: The website (www.smstc.ac.uk) is crucial!

Study the notes, do the exercises, follow up on suggested texts, etc.
Some modules are 'flipped': you're expected to read in advance.

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Ask your PG coordinator about your local arrangements.

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Assessment: Each core module is assessed in either one or two assignments.

You get written feedback, a grade for each assignment, and an overall grade for the module. All this is visible to your supervisor.

How many modules should I do?

Your postgraduate director decides what's required (not us).

- A 'typical' load (original EPSRC expectation): 6 modules.
- We don't require you to take them all in the same year!
- Your choices should be to widen your knowledge, not to support your research directly.

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Examples:

- Student A has started a PhD straight from UG. They take six core modules.
- Student B did a lot of high-level courses in their MSc, so only takes three modules: two core, one supplementary.
- Student C takes four core modules, but wants to learn some other subjects that SMSTC doesn't offer, so also takes a UG course and a reading course.

How much time does all this take?

Typically, about **75% of your time for the first six months of your PhD** is intended to be spent on training.

Make sure your supervisor doesn't overload you with other work.

Warning: You are likely to have clusters of assignment deadlines around the middle and end of semesters.

Plan ahead for this!

What doesn't SMSTC do?

SMSTC doesn't force you to do anything.

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SMSTC doesn't provide tutorials.

These are the responsibility of your department.

Lectures are done centrally by videoconference—organized by SMSTC.

Tutorials are done locally in person—organized by your department.

If you're not being offered tutorial support, *complain to your department!*

Questions and feedback

Some mechanisms for asking questions or providing comments:

- **Local tutors:** e.g. specific mathematical points.
- **Lecturer:** e.g. points that your tutor can't answer.
- **Theme Head:** e.g. feedback on course provision.
- **PG coordinator and supervisor:** e.g. questions about your training.
- **SMSTC administrators:** purely administrative questions.
- **SMSTC Director:** questions / comments about SMSTC overall.
- **Student reps:** anything you'd like to be passed on anonymously.
- **Formal feedback process:** in March and April.
- **Me, now:** ...?

What now?

Today and tomorrow:

- An overview of each theme and supplementary module, including content, prerequisites and assessment, and helping you
 - ▶ make up (or change) your mind on which modules to take;
 - ▶ broaden your knowledge, even if you've already chosen.
- Presentations on some useful stuff for PhD students to know.
- Meeting students and staff from universities across Scotland.
- Some fun networking and team-building: bowling and dinner.

Later in the year there will be two follow-up events:

- Further research skills
- Supporting Postgraduates who Teach Mathematics & Statistics

We'll provide further details closer to the time.