Aims

The objective of this course is to discover where mathematical concepts and methods appear in the world surrounding us. We will start from various real-life situations and then construct the mathematical tools required for their analysis. We will introduce some of the novel techniques from mathematics, and combine background theory, practical applications and case studies.

Syllabus

Mathematics is everywhere — it can be found in the natural and social sciences, in engineering, in administration, even in economics. Many of the technical devices that we use every day rely upon mathematical methods. We will look into the following chapters:

**Maths in sports:** How to throw a ball? How to add performances in decathlon and heptathlon? How do world records evolve over time?

**Maths in production planning:** How to optimize the workload of machines?

**Maths in your SatNav:** How does a SatNav device determine first its distances to the satellites? How does it subsequently determine its location on the earth?

**Maths in your mobile phone:** How does a mobile phone estimate the channel state information when it connects to the base station?

**Maths in physics:** Why can’t we travel faster than light? What does special relativity really mean?

**Maths in nature:** What is a rainbow? Why are the colours in a secondary rainbow in reverse order?

In each chapter, real-world situations will lead us to the following mathematical concepts: functions and their derivatives; finding zeroes of nonlinear functions; matrices acting as mappings, and vectors; systems of linear equations and their solutions; computing with residues modulo two; division of polynomials; Hamming distances; correlation of signals; elementary concepts of probability theory; co-ordinate systems and how to transform between them; geometry; elementary numerical mathematics.

Teaching and Assessment

**Contact Hours:** 4 interactive sessions per week

**Assessment:** 100% by class tests or other continuous assessment

**Resit Type:** Exam

Content: 12 August 2015
By the end of the course, students should be able to:

- understand basic mathematical objects and how they appear in applications
- understand the role of mathematics in everyday life
- understand that realistic applications have a non-trivial complexity and require careful working
- appreciate that handling realistic applications of mathematics requires knowledge of at least one other science (such as physics) and often more than one area of mathematics
- understand the problems of modelling reality