

## **Course content for MT1100, From Euclid to Mandelbrot**

### **Prerequisites:**

Mathematics A-level or equivalent

### **Aims:**

This course aims to show how mathematics has been used to describe space over the last 2500 years and use this to motivate the study of various aspects of the subject.

### **Learning outcomes:**

On completion of the course, students should be able to

- Appreciate what can be done with ruler and compass constructions;
- Sketch simple curves using plane polar coordinates;
- Sketch and classify conics, and find their foci and directrices;
- Understand the concepts of self-similarity and fractal dimension;
- Use simple arguments to distinguish between countable and uncountable sets;
- Analyse the logistic map and similar iterated maps;
- Explain the period-doubling route to chaos.

### **Course content:**

Geometry: Ruler and compass constructions (up to the regular pentagon). Platonic solids. Euler's formula. Plane polar coordinates.

Conics: Cartesian and polar forms, focus and directrix.

Fractals: Self-similarity, fractal dimension, Koch snowflake, Cantor dust, Sierpinski gasket.

Countability: Countability of rationals, uncountability of reals and of the Cantor set.

Iteration: Iterative maps, cobwebbing, fixed points, limit cycles, stability, logistic equation, period doubling. Chaos. The Mandelbrot set. Bilinear transformations.

Fibonacci numbers, the golden mean.