

## Perspectives on Geometry

Mathematics 303

Section: D100

Term: 2012 Fall

Instructor: Randall Pyke

### Discussion Topics:

Fractals are infinitely complex geometric objects and lie at the foundation of so-called Chaos Theory. They were first discovered over 100 years ago but required the advent of computers to explore their properties fully. Fractals have become a prominent subject both within mathematics and within subjects outside mathematics such as physics, biology, and economics to name a few. This will be an introductory course that explores fractals theoretically and experimentally using computer software.

### Course Outline

- Introduction to fractals. Self-similarity. Fractals in mathematics and nature. Preliminary examples; the Cantor set, Sierpinski's triangle, von Koch curve.
- Creating fractals. Iterated Function Systems (recursion).
- Properties of fractals. Fractal dimension. Estimating fractal dimension. Creating fractals with prescribed fractal dimension.
- The Chaos Game. Addresses on a fractal. Understanding why the chaos game works.
- Applications. Fractal image compression, fractal landscapes, Brownian motion, applications in biology.
- The Mandelbrot set and Julia sets. Complex numbers and iteration of complex functions. Properties of the Mandelbrot set and Julia sets. Drawing the Mandelbrot set and Julia sets.

### Grading: Assessment:

2 midterms

4 homeworks

Optional project in lieu of final exam

Required Texts: No textbook will be required; class notes will be provided.

Some computing with Matlab, Maple or other software of your choice will be required.

### Suggested references:

Chaos and Fractals; New Frontiers of Science by Pietgen, Jurgens and Saupe; Fractal Geometry: Mathematical foundations and applications by Kenneth Falconer; The Science of Fractal Images by M.F. Barnsley et. al.; Fractals Everywhere by M.F. Barnsley; The Fractal Geometry of Nature by B. Mandelbrot.

### Recommended Texts:

### Materials/Supplies:

### Prerequisite/Corequisite: Prerequisite:

MATH 152 or 155 or 158 and MATH 232 or 240.

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Notes: Quantative.

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ANY OF THE ABOVE INFORMATION.

Students should be aware that they have certain rights to confidentiality concerning the return of course papers and the posting of marks. Please pay careful attention to the options discussed in class at the beginning of the semester.

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