

Proposed Special Topics Course by Ken McLaughlin:

Universality: Singular limits of partial differential equations and random matrices

Prerequisites: complex analysis

Universality refers to the emergence, typically in limits that nearly defy comprehension, of phenomena that are paradoxically independent of the exact nature of the singular limits in question.

A well - known example of this is the universal behavior of eigenvalues of random matrices. Another, less well-known example is the universal behavior of fluctuations in random tiling problems.

Even more recently it has been observed and conjectured that entire families of partial differential equations regularize shocks through the generation of vigorous oscillations in a universal manner.

In this course we will cover the following topics:

1. Introduction to integrable nonlinear partial differential equations and singular limits of them (3-4 weeks).
2. Introduction to random matrices and universality (3-4 weeks).
3. Random tilings and universality (2-3 weeks)
4. Open research directions: singular limits of partial differential equations and random matrices (remaining time)