LTCC Basic Course

Title: Analytical Methods

Basic Details:

- Core Audience: 1st yr applied mathematics students
- Course Format: 5 x 2hr lectures

Prerequisities: Familiarity with partial differential equations (PDE) including standard equations such as Laplace's equation, wave equation, heat equation is expected. Some understanding of standard methods of solving these equations, e.g. separation of variables and transform methods is also required. Some basic tools from complex analysis will be used.

Course Description:

- Keywords: perturbation methods; partial differential equations; boundary layers; matched asymptotics; multiscale analysis; WKB

- Syllabus:
  This course is a mixture of perturbation methods and PDEs.
  The content taught each week will be
  1. Introductory material. Regular perturbation expansions. First-order PDEs. Characteristics.
  2. Scaling and dimensional analysis. Similarity solutions. Homogeneous and inhomogeneous wave equation. Characteristics in second order systems.
  3. Stretching coordinates. Scale and stretch with nonlinear DEs. Classification of PDEs. Separable solutions.
  4. Matched asymptotic expansions. Intermediate variables; finding the boundary layer. Complex analytic methods.
  5. The WKB and related methods. Method of steepest descents

Recommended Reading

- Bender and Orszag, *Advanced mathematical methods for scientists and engineers.*
- Hinch, *Perturbation methods.*
- Weinberger, *PDEs with complex variables and transform methods.*
- Holmes, *Introduction to Perturbation Methods*

Format:

Printed lecture notes will be available. There are five weekly problem sheets, with full worked solutions made available at the end of the course.

Lecturer Details:

- Lecturer: Professor Nicholas Ovenden
- Lecturer home institution: UCL
- Lecturer e-mail: n.ovenden@ucl.ac.uk