ChE230B/ME244B
Advanced Theoretical Methods for Engineers
Winter 2010

Course goals:

to introduce to the basic ideas of the asymptotic and perturbation analyses via intuitive and physically motivated examples, and then to build up a coherent methodology for solving research-type problems.

Topics to be covered:
- Introduction to and motivation for approximation techniques: solving algebraic equations
- Non-dimensionalization, dominant balances, orders of magnitude
- Regular vs. Singular perturbations
- Necessary elements of complex analysis: analytic and non-analytic functions, residue calculus
- Asymptotic analysis of integrals (steepest descent, Laplace's method, asymptotics of integral transforms)
- Stokes phenomena and terms `beyond all orders'
- Ordinary and partial differential equations:
  - Singularities in ODE's, classification and analysis
  - Regular and singular perturbations
  - Boundary layers and matched asymptotics
  - Multiple-scales analysis
  - WKBJ methods
  - Application of the methods to PDEs

Course grading:

Homeworks will play a very significant role in determining your grade. In working on the homework you are welcome to discuss the problems with each other, but the work you turn in must be your own. Grading policy:
- 30% Homework
- 30% Midterm Exam
- 40% Final Exam (take-home)

Suggested textbooks (on reserve):
- R.V. Churchill, *Complex variables and applications*, McGraw-Hill, 1984
- M.Van Dyke, *Perturbation methods in fluid mechanics*, Parabolic Press, 1975
- J.D. Cole, *Perturbation methods in applied mathematics*, Blaisdell Pub. Co., 1968

Instructor: Prof. Rouslan Krechetnikov
Lectures: TR 12:30-1:45 pm at Engineering II 3301
Office hours: T 2:00-4:00 pm or by appointment