



DEPARTMENT OF  
MATHEMATICAL SCIENCES

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## Course Announcement, Spring 1998

### **MATH 823: Perturbation Methods for Differential Equations** MW 2:30-3:45

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Often in physical systems, certain small or large parameters will naturally occur. Perturbation methods involve the use of such parameters to simplify the governing equations so they can be solved. These simplifications (and the regions in which they do not hold) often provide insight into the dominant dynamics of the physical system.

This course will explore the use of perturbation methods to solve differential equations arising in science and engineering. Students should have taken a course in ordinary differential equations and have some knowledge of partial differential equations. Depending on the makeup of the class, the topics covered will be some subset of the list below:

#### **Mathematical Techniques**

- The WKB method
- Multiple-scale expansions
- Asymptotic expansions of integrals
- Regular and singular perturbation methods
- Perturbed bifurcation problems

#### **Application Areas**

- Momentum, mass, and energy transport, reaction-diffusion systems
- Incompressible fluid flow
- Mathematical biology
- Environmental design and cleanup
- Linear and nonlinear oscillations
- Linear and nonlinear optics
- Quantum mechanics
- Dynamical systems and chaos
- Resource extraction
- Linear elasticity and viscoelasticity

At the end of the term, the successful student will be able to

- Examine a mathematical model for a physical system to find suitable dimensionless small (large) parameters for asymptotic analysis
- Use asymptotic and perturbation methods to simplify the system, either
  - to construct an approximate analytic solution, or
  - for reduction of stiffness/complexity/order of the system in preparation for numerical solution

Further questions may be directed to the instructor.