Instructor: Prof. Keith Julien, ECOT 321, 303-492-5753, julien@colorado.edu

Lecture Time & Location: MWF 11-11:50am, ECCR 257 Newton Lab

Office hours: Julien: MW 12-1pm or by appt; Asst. TBA

Course webpage: http://amath.colorado.edu/content/appm-5480-methods-applied-mathematics-approximation-methods-spring-2019

Course Overview: Covers asymptotic evaluation of integrals (stationary phase and steepest descent), perturbation methods (regular and singular methods, and inner and outer expansions), multiple scale methods, and applications to differential and integral equations.

Approximate, asymptotic methods are indispensable tools for the applied mathematician, in league with computational and exact solution methods. Very often in applications, there are physical, nondimensional parameters $\mathbf{p} \in \mathbb{R}^n$ that are small, yet essentially nonzero. Perturbative methods allow one to extend knowledge of the (often well-understood) $\mathbf{p} = \mathbf{0}$ case to the small $|\mathbf{p}|$ case and beyond. These tools are not only beneficial for applications in the physical, biological, and social sciences themselves but also for numerical methods where many computational difficulties arise when parameters are small, e.g., the numerical solution of stiff ODEs or PDEs. Also, many precise results in analysis, number theory, and probability/statistics are formulated in terms of asymptotics.

Prerequisites: Partial differential equations (APPM 5470) or instructor consent, restricted to graduate students only.

Tentative **Course Outline:**

Week	Material Covered
1–3	Asymptotic methods for algebraic equations
3–5	Asymptotics of integrals: Laplace's method, stationary phase, steepest descent
6–10	Regular and singular perturbation methods for ODEs, applications
11-15	Perturbation methods for PDEs, applications

Primary Text: C. M. Bender, S. A. Orszag *Advanced Mathematical Methods for Scientists and Engineers*, Springer, NY 1999.

Grading: 60% for six problem sets, 20% for in-class 25 minute project presentation, 20% for project report. The standard grading scale, subject to possible *down*shifting, will be used, e.g. 90-100% A, 80-89% B, etc.

Homework: Six approximately bi-weekly problem sets will be assigned. You are encouraged to discuss homework with other students or with me. You must write up your own work legibly and clearly. It is self evident that you must comprehend the material and be able to solve the problems on your own. Homework will be graded on a 0-100 scale based on the amount attempted and detailed grading of selected problems. Your time and my time are valuable. **Therefore, if I cannot understand your results (e.g. incomprehensible proofs, poorly written calculations, etc.), then you will get the problem wrong.** Late homework will not be accepted.

Assignment Schedule	Date Assigned	Due Date
Homework 1	Jan 18	Jan 30
Homework 2	Jan 30	Feb 13
Homework 3	Feb 13	Feb 27
Homework 4	Feb 27	Mar 13
Homework 5	Mar 18	Apr 3
Homework 6	Apr 3	Apr 17
Homework 7	Apr 17	May 1
Project Presentations: Apr 29–May 3		

Class Policies:

- Classroom discussion and questions are encouraged and supported.

- The instructor will organize another lecturer or make-up lectures for classes missed due to travel or sickness.

- Come to class as some of the material to be presented in lecture will not be contained in the required text.

- Arrive on time (5 minutes early if possible) as warm-up problems and important announcements are presented at the beginning of class.

- Late homework will not be accepted.

- Written requests issued by the Office of Disability Services will be honored.

Students with disabilities (official CU policy):

If you qualify for accommodations because of a disability, please submit to Professor Hoefer a letter from Disability Services in a timely manner so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities. Contact Disability Services at 303-492-8671 or by e-mail at dsinfo@colorado.edu. If you have a temporary medical condition or injury, see Temporary Medical Conditions: Injuries, Surgeries, and Illnesses guidelines under Quick Links at Disability Services website and discuss your needs with Professor Julien.

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