Math 501: Analytic Methods in Applied Mathematics

Fall 2023

Instructor:	Dr. Stathis Charalampidis	**Office:**	25-319 (Faculty Offices East)
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Course Web Page: https://www.egcharalampidis.com/teaching/501_F23/math_501_F23/

Class Meetings:

- TR: 7:10-9:00am (38-148)

Office Hours: TR 11:15am-12:45pm, or by appointment.

Required Textbook:

- *Advanced Mathematical Methods for Scientists and Engineers I: Asymptotic Methods and Perturbation Theory*, Authors: Carl M. Bender and Steven A. Orszag, Publisher: Springer-Verlag.

Extra References

- *Perturbation Methods* (Cambridge Texts in Applied Mathematics, Series Number 6), Author: John Hinch, Publisher: Cambridge Press.
- *Introduction to Perturbation Methods*, Authors: Mark H. Holmes, Publisher: Springer-Verlag.
- *Introduction to the Calculus of Variations*, Author: Bernard Dacorogna, Publisher: Imperial College Press.

Objectives: Many realistic mathematical models that arise in Science and Engineering are unlikely to be solved explicitly, that is, exact solutions are very hard to be obtained. Judicously selected numerical methods may be promising in overcoming this issue although most of the times analytical insight may be of great help in not only understanding/interpreting numerical results but also developing numerical methods. In this graduate-level course, we will focus on the development of analytic techniques that will allow us to obtain good and reasonable approximations to such models. Among the wide palette of techniques and methods that are timely in Applied Mathematics, this class will discuss approximation methods for solving linear and nonlinear differential equations, regular and singular perturbation theory, boundary layer theory, Wentzel–Kramers–Brillouin (WKB) expansions and applications to eigenvalue problems, as well as multiple-scale techniques.

https://content-calpoly-edu.s3.amazonaws.com/math/1/documents/501.pdf

Class Material by Topic: During the quarter, we will cover the following topics from the main textbook (B & O):

- Review of ODEs theory (Chapter 1)
- Local Analysis of linear and nonlinear ODEs (Chapters 3 & 4)
- Perturbation series for ODEs and eigenvalue problems (Chapter 7)
- Boundary layer theory (Chapter 9)
- Wentzel–Kramers–Brillouin (WKB) theory (Chapter 10)
- Multiple-scale analysis (Chapter 11)

Course Prerequisites: Math 344 or Aero 300, and graduate standing.

Homework, Written and Oral Exams: There will be (almost) weekly **written** homework assignments that will be posted on Canvas. Each assignment will consist of a group of problems that will be taken from the main text (B & O), and your task will be to write up solutions for each one. There will be **one written in-class midterm exam** and **one written (in-class) final**. Moreover, there will be an **oral examination** on the homework problems. For their schedule, see below the "Important Dates" section of this document.

Grading Policy and Exams: Your final grade in this course is computed according to:

Attendance & Class Participation	5%
Homework	25%
Oral Exam (on HW)	5%
Midterm	30%
Final Exam	35%

Important Dates and Academic Holidays:

Midterm	Thursday, October 26
Veteran's Day	Friday, November 10
Thanksgiving Break	Monday-Sunday, November 20-26
Last day of classes	Friday, December 8
Oral Exam (on HW)	TBD
Final Exam	Tuesday, December 12, 7:10am –10:00am

Class Policies:

- All exams are **paper and pencil** exams.
- All exams (including written and oral ones) will be closed-book. All exams are primarily based on the material we cover in class and the homework.
- Absolutely no formula sheets and class notes are allowed during midterm, oral, and final exams.
- If a calculator is needed during the exams, I will let you know in advance to bring one.
- Please inform me as soon as possible if you are seeking to make up missed work pursuant to the excusable reasons listed in the url below:

https://academicprograms.calpoly.edu/academicpolicies/class-attendance

Students with Disabilities: The University provides disability-related support services to qualified students through the Disabilities Resource Center (DRC). If you have a disability for which you are or may be requesting an accommodation, you are encouraged to contact both me and the DRC (124-119) at (805) 756-1395, as early as possible in the term. In addition, and for your convenience, their website is:

https://drc.calpoly.edu/

Note that use of DRC services including testing accommodations requires prior authorization by the DRC and compliance with approved procedures. **Make sure you initiate any needed arrangements well in advance of an exam date**.

Diversity and Inclusion: I am fully committed to an academic environment that is free of bias against any group and I firmly believe in the value of diversity in people and ideas. My ultimate goal is to establish that this class is a welcoming environment to every-one regardless of gender identity, sexual orientation, color, race, ethnicity, or religious identity. The University and I do not tolerate discrimination. Please feel comfortable coming to me if at any point you ever feel uncomfortable for any reason.