

Time and Place: T, Th 2:30-3:50, MOR 230

Course Website: <http://faculty.washington.edu/hqian/amath383/>

Instructor: Prof. Hong Qian

Office hours: Wednesday 10:00-12:00, Lewis Hall, Rm. 319

Teach Assistant: Mr. Lowell Thompson

Office hours: Monday 2:00-4:00 PM, Lewis Hall, Rm. 129

1 Course Description

*Introductory survey of applied mathematics with emphasis on modeling of physical and biological problems in terms of differential equations and elementary probability theory. Formulation, solution, and interpretation of the results are three separated, but equally important, stages of a single **mathematical modeling project**.*

The course consists of a series of independent topics in a wide variety of fields of application. No background in these areas are required.

2 Syllabus

What is mathematical modeling? How has it been used? What do we want to learn?

From data to mathematical models; discrete and continuous models, deterministic and stochastic models (CH. 1 + Lecture Notes §1.2)¹

Dynamics: state space, change one step at a time (CH. 3): From the simple problem of compound interest to Newton's mechanics.

Population dynamics: biological and ecological modeling, biochemical modeling; probabilistic reformulation of population kinetics (CH. 4 + Lecture Notes Chapter 3)

Population dynamics with age distribution and scaling law (CH. 2)

Modeling in classical physics, the case study on one of the best example: From Kepler to Newton (CH. 5)

Differential equation boot camp: Phase planes, fixed points, linear analysis and **qualitative description** in terms of mathematics (CH. 6, and chapter 9 of Boyce-DiPrima)

Models of population species with interaction, predator and prey in ecology, biochemical regulatory factors inside a living cell, and other interacting species (CH. 9 + Lecture Notes)

Global warming controversy: Ice ages and snowball earth (CH. 8)

Conflict models, war games, marriage and divorce (CH. 10).

Chaos, and the end of certainty? (CH. 7)

Mathematics of weather, El Nino; and age of the earth (CH. 12, 13)

¹CH indicates the chapter in the textbook.

3 Textbook

Topics in Mathematical Modeling, by K.K. Tung, Princeton University Press, Hardcover. (It is available at the University Book Store.)

4 Reference Texts

These are references for you to consult when needed for your term projects.

(1) *Mathematical Modelling with Case Studies: A Differential Equation Approach Using Maple*, by B. Barnes and G.R. Fulford, Taylor and Francis Publishers, 2002.

(2) *Modeling Differential Equation in Biology*, by C.H. Taubes, Prentice-Hall, 2001.

(3) *Mathematical Models: Mechanical Vibrations, Population Dynamics, and Traffic Flow*, by Richard Haberman, SIAM Pub., 1987.

(4) *Differential Equation Models*, by M. Braun, C.S. Coleman, D.A. Drew, Springer-Verlag, 1983.

(5) *Modelling with Differential Equations*, by David N. Burghes and Morag S. Borrie, John Wiley & Sons, 1982.

5 Evaluation and Grading

There will be no exams. There will be 5 homework assignments, each counting 10% towards the final grade. There is a term paper (40% of the final grade). The remaining 10% is for class participation.

Term Paper:

A term paper can either be on an original project or a review of literature on a topic of interest to you. Please read carefully the guidelines for term paper, written by Prof. K. K. Tung, a former chair of amath department, at

<http://faculty.washington.edu/hqian/amath383/proj.pdf>

A major feature of this introductory mathematical modeling course is that students develop course projects and write term papers on those projects. These term papers are to be turned in during the last day of classes. You are strongly encouraged to team up with your classmates for the term paper. But no more than three students can collaborate on the same project. A list of possible topics can be found here

http://faculty.washington.edu/hqian/amath383/proj_list.pdf

There are two components for a term paper: You need to hand in a two-page *proposal* by **November 14, 2019**, the end of the seventh week. You might, but not *necessarily*, hear from us with feedbacks. A final version is due on **December 6, 2019**, the last day of instruction.

The term paper will be graded in terms of *originality and novelty* (thoroughness of review), *mathematical content* (depth, explanations, exposition, appropriateness), *accuracy and validity*, *presentation clarity* (logic, thought, writing), and *style* (spelling, grammar, references, handling of equations), with 20% each.

Because the focus of mathematical modeling and insufficient writing involved in this class, there will be **no** “W” credit given in this class.

6 Important Dates

First day of classes: Thursday, Sept 26.

First homework posted on line: Thursday Oct. 3 - due a week after.

Proposal of the term paper due: Thursday, Nov, 14.

Last day of lecture: Thursday, December 5.

Term paper due: Friday, December 6.