APMA 0340: Applied Mathematics – II

Course Code (CRN):	17006
Class Location:	Barus & Holley, room 161
Class Time:	12 (noon) – 12:50, Mondays, Wednesdays, and Fridays

Instructor:	Vladimir Dobrushkin, Ph.D. and Dr. Sc.
Email:	Vladimir_Dobrushkin@brown.edu
website:	http://www.cfm.brown.edu/people/dobrush/am34/index.html
Office Location:	170 Hope Street, room 304
Office Hours:	Mondays, Wednesdays, and Fridays, 8am – 11:20
Phone:	(401) 863-1447

Course Description: Mathematical techniques involving differential equations used in the analysis of physical, biological, and economic phenomena. Emphasis on the utilization of established methods, rather than rigorous foundations. Computational packages are used for solving differential equations and visualization of their solutions. The course is comprised of three parts. I: Applications of linear algebra to systems of linear ordinary differential equations. II: Solutions of nonlinear systems of ordinary differential equations, based on corresponding numerical techniques and qualitative analysis, including chaos, periodic solutions, and stability. III: Fourier series and introduction to partial differential equations.

Textbook: "Applied Differential Equations: The Primary Course" by Vladimir A. Dobrushkin, 2015, Chapman and Hall/CRC. ISBN 9781439851043
https://www.crcpress.com/product/isbn/9781439851050

Additional Resources:

- Online tutorial: http://www.cfm.brown.edu/people/dobrush/am34/computing.html
- Elementary Differential Equations and Boundary Value Problems, by William E. Boyce and Richard C. DiPrima; Publisher: Wiley
- Differential Equations with Boundary-Value Problems, by Dennis G. Zill, Michael R. Cullen; Publisher: Brooks/Cole Pub Co; ISBN: 0534380026
- A First Course in Differential Equations with Modeling Applications by Dennis G. Zill; Publisher: Brooks/Cole Pub Co; ISBN: 0534379990
- An Introduction to Laplace Transforms and Fourier Series (Springer Undergraduate Mathematics Series) by Phillip P. G. Dyke

Prerequisites: Elementary Calculus and APMA0330

Course Outcomes:
Students completing APMA 0340 should

1. Understand how to solve a system of linear differential equations using Linear Algebra techniques.

2. Be able to critically read, analyzes, and interpret the scientific literature in ordinary and partial differential equations.

3. Apply knowledge gained from the course and numerical techniques to analyze and visualize solutions of nonlinear differential equations.

4. Be able to identify stability of equilibrium solutions, existence of periodic solutions to nonlinear equations, and numerically show chaotic behavior of solutions.

5. Understand the basic concepts of Fourier series and apply Cesaro summation to eliminate Gibbs phenomenon.

6. Be able to apply the separation of variables method to solve some initial boundary value problems of mathematical physics.

Grading Policy: The primary instructor of a class is the sole authority for reporting and/or changing a course grade. The first and final exams are take home; so late submission will not be excepted. Students may be asked to submit their codes electronically for further verification. In-class second exam will be no more than one hour in length. Makeup examinations will be given only to students who notify me in advance through the Dean's office or by written medical excuse. Valid excuses from the Dean's Office, Athletic Department, Physician, or Religious holiday will be accepted.

Partial credit will be given only for accomplishing all correct steps in the solution procedure. No books or notes are permitted in the second exam.

Final grades will be based on the following distribution:

Grade Distribution:

Midterm Exam 1	25%
Midterm Exam 2	25%
Assignments	25%
Project	0%
Final Exam	25%

Grades are reported and recorded as letter grades:

Letter Grade Distribution:

>= 93.00	A
83.00 - 86.99	B
73.00 - 82.99	C
<= 69.99	F

Course Website: All homework assignments may be found on the course web site:
http://www.cfm.brown.edu/people/dobrush/am34/f18/hwork34.html
Course announcement will be posted on the course Canvas website (canvas.brown.edu).

Academic Honesty: As a Brown University student, you have agreed to abide by the University's academic honesty policy:
https://www.brown.edu/academics/college/degree/sites/brown.edu.academics.college.degree/files/uploads/Academic-Code.pdf

All academic work must meet the standards described in the Academic Code. Lack of knowledge of the academic honesty policy is not a reasonable explanation for a violation. Questions related to course assignments and the academic honesty policy should be directed to the instructor.

Authorship:

The student must clearly establish authorship of a work. Referenced work must be clearly documented, cited, and attributed, regardless of media or distribution. Even in the case of work licensed as public domain or Copyleft, (See: http://creativecommons.org/) the student must provide attribution of that work in order to uphold the standards of intent and authorship.

Homework: Will be assigned every session and is due in class the following session; you may also deposit it in the drop-off box (situated in the lobby of the main Applied Math building, 182 George Street) or put into the folder outside my office (170 Hope Street, room 304). Late homework may not be accepted for grading. A student, who for some reason cannot submit the homework in time, must inform the TA at least one day before the due day. The homework is sometimes meant as a preparation for the course, and not just an exercise of material already covered. It is therefore a substantial part of the course, not an appendix to it.

Important Dates:

Classes begin	September 5
Add a Course Deadline	September 20
Add Deadline with fee	October 2
Columbus Day	October 2
First Test (take home)	October 10
Mid semester deadline	October 19
Second Test (in class)	November 7
Project Deadline	November 14
Thanksgiving recess	November 21
Reading period	December 8
Course Final exam (take home)	December 10

Extra Help: Do not hesitate to come to my office during office hours or by appointment to discuss a homework problem or any aspect of the course. You also may want to consider the Math Resource Center http://www.math.brown.edu/mrc/

Tentative Course Outline:

The weekly coverage might change as it depends on the progress of the class. However, you must keep up with the reading assignments.

Week	Content
Week 1	• Introduction • Derivation of systems of ordinary differential equations
Week 2	• Matrix Algebra • Basic operations with matrices
Week 3	• Eigenvalues and eigenvectors • Solving linear systems of equations
Week 4	• Functions of a square matrix • Fundamental matrices
Week 5	• Solving systems of first order equations • Solving systems of second order equations
Week 6	• Nonlinear differential equations • Stability analysis of equilibrium solutions
Week 7	• Linearization of nonlinear equations • Applications to population modeling
Week 8	• Phase portraits • Locally linear systems (applications)
Week 9	• Lyapunov second method • Periodic solutions and limit cycles
Week 10	• Numerical applications • Chaos and strange attractors
Week 11	• Fourier series • Gibbs phenomenon
Week 12	• Sturm–Liouville problems • Cesaro summation
Week 13	• Partial Differential Equations • Separation of variables
Week 14	• Partial Differential Equations • Dirichlet and Neumann problems