

Math 353 - Mathematical Modeling – Fall 2020

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Office hours: See Web Page

Course Objectives: This course is pivotal in the undergraduate mathematics curriculum. The student will learn to apply mathematical theory, both summarizing and motivating the material in other courses, to a wide variety of real-world problems.

Help: As we are online this semester, it is more important than ever that you ask questions. When you have a question, please speak up so that I can hear you. Make sure that you are not muted. I won't be able to watch the screen all the time and I don't want to miss an important question. If you see a classmate needing to ask a question please help bring it to my attention. You can also seek help during office hours.

Web Page: Homework assignments, review sheets, and general course information will be posted on my web site at <http://faculty.rmwc.edu/mordower/math353/>

Grading: Your grade will be determined according to the following scheme.

Midterm	Homework	Final Project	Final Exam
20 %	30%	20%	30%

Electronics Policy: Because of the unusual circumstances, I will have a radically different electronics policy this semester. You may always use a calculator, though you may not use the calculator to produce a graph. You may use a calculator app on your phone as a calculator, even during exams. You MAY talk to **your classmates** during class on a chat app. You MAY NOT communicate with people not in the class during class, and you may not communicate with anyone except me nor consult with any other resources while you are taking an exam.

Accommodations Randolph College is committed to providing learning experiences that are accessible for all students, and will make reasonable accommodations for individuals with documented disabilities. If you have a learning difference or a disability mental health, medical, or physical impairment please contact Diane Roy, Coordinator of Access Services, in the Academic Services Center, 4th floor, Lipscomb Library; at (434) 947-8132; or at droy@randolphcollege.edu.

Academic Honesty: The honor code protects our academic community and the value of a degree from Randolph College. An instance of cheating not only reflects the perpetrator's failure to complete work honestly, but also damages the reputation of every other student at the College. Please uphold both sides of dual responsibility. Approaching a classmate about suspicion of cheating is never easy, but it is an essential part of the system. If you keep silence in the knowledge that rules have been broken, you are guilty of an honor code violation.

It goes without saying that you should never pass off someone else's work as your own. During midterm and final exams, make certain that your work is unassisted and keep your work confidential. For homework pledge problems, using someone else's solution (whether that solution is from a classmate, a solution manual, or any other source) is prohibited. Past or current copies of final exams are intended to be confidential. If you find that they are not, please report it to me right away. They should never be photographed, recorded or transmitted in any way.

I encourage you to work and study together. It can be an effective way to learn mathematics. The admonition to work alone covers homework pledge problems and exam problems only. Feel free to discuss any other problems from any other sources. If you are not certain whether or not something is allowed, please ask.

The Structure of This Course:

The lecture time in this class will be divided roughly equally amongst the following: Mathematical theory, the methodology of mathematical modeling, and the study of actual models. For the most part, the Thursday of every week will be devoted to theory.

Depending on the interests of the class, I would like to study models of the following: population size (predator - prey, limited resources, etc.), heat flow, infection rates, economic systems, climate and weather, service contracts, and anything else in which class members show interest.

Topics

A. Modeling

1. Creating Models
 Calibration and Validation
 How one decides on parameters
 How one sets the value of a parameter
 Curve fitting

 Interpolation and extrapolation
2. Dynamic Systems
 Time series
 Markov Chains
 State diagrams
 Compartmental Analysis - Continuous time
 Heat Flow - Continuous space
3. Analysis of Dynamic Models
 Ephemeral effects
 Long term effects
 Fixed points
 Stability
4. Stochastic Models

B. Theory

1. Dimensional Analysis
 Scaling
2. The Complex Numbers
 Advantages of using the complex numbers
 Applications of the Fundamental Theorem of Algebra
3. Linear Functions and Spaces
 Eigenvalues and Eigenvectors
 Similarity
 Jordan Canonical Form
4. Difference Equations and Iteration
 Difference equations as an approximation to differential equations
5. Differential Equations
 The relationship between difference equations and differential equations
 Series Solutions
6. Networks
 Flows and the Max-Flow-Min-Cut Theorem