Course Subject, Number and Title
Math 319: Techniques in Ordinary Differential Equations

Credits: 3

Canvas Course URL: https://canvas.wisc.edu/courses/199524

Course Designations and Attributes: None

Meeting Time and Location: MTWR 8:55-10:10 am. Online at the Canvas site

Instructional Mode: Online Instruction

Specify how Credit Hours are met by the Course: Four 75 minute lectures per week for 8 weeks and 4 hours per week outside the class for 8 weeks

Instructor Title and Name: Frank Rooney.

Instructor Email: frooney@math.wisc.edu

Office Hours: Tue/Wed/Thu/Sat 1-2 pm or by appointment, on the canvas site

OFFICIAL COURSE DESCRIPTION

Course Description
As approved through governance, presented in the Guide.

Requisites: Math 222.

Course Content

Unit 1: First Order Ordinary Differential Equations

2. Separable equations
3. Linear first order equations
4. Other equations that can be solved in closed form
5. Qualitative behavior of autonomous equations – Equilibrium
6. Approximate methods of solution of differential equations
7. Applications of differential equations to physical situations

Unit 2: Higher Order Linear Differential Equations

1. Existence and uniqueness for higher order linear differential equations
2. The Wronskian
3. Homogeneous solutions to differential equations
4. Solution of inhomogeneous equations – Undetermined coefficients & Variation of parameters
5. Constant coefficient linear differential equations
6. Application of constant coefficient differential equations to physics and engineering

Unit 3: Other Methods of Solution of Linear Differential Equations

1. Laplace transforms of simple functions
2. Using Laplace transforms to solve constant coefficient differential equations
3. Solving constant coefficient differential equations with discontinuous forcing
4. Convolution
5. Power series
6. Using power series to solve differential equations

Unit 4: Boundary Value Problems and Fourier Series

1. Ordinary differential equations arising from partial differential equations
2. Fourier series
3. Solution of partial differential equations using Fourier series

Unit 5: First Order Systems of Differential Equations

1. Linear first order systems.
2. Eigenvalues and eigenvectors of matrices
3. Using eigenvalues and eigenvectors to solve linear first order systems

Course Learning Outcomes

Students should be able to

1. First Order Differential Equations

Solve the following: first order linear differential equations, separable equations; Bernoulli equations, exact equations

Apply solutions of first order differential equations to physical situations.
Know the difference between linear and nonlinear equations and determine whether a given initial value problem has a unique solution

2. Higher Order Linear Differential Equations
Use the Wronskian, the principle of superposition of solutions, and Abel's theorem to solve second order homogeneous equations
Solve constant coefficient differential equations using the characteristic equation.
Use Euler's formula to solve characteristic equations with complex roots;
Solve equations by the method of reduction of order.
Solve second order non homogeneous equations using the method of undetermined coefficients and variation of parameters.
Apply the solutions to study problems of mechanical vibrations and electrical circuits.

3. Other Solution Methods for Linear Differential Equations
Compute the Laplace transform and the inverse Laplace transform of various functions
Solve second order initial value problems using the Laplace transform
Solve differential equations with step and impulsive forcing functions

4. Boundary Value Problems and Fourier Series
Solve homogeneous and non homogeneous boundary value problems
Find Fourier series of various functions.
Use Fourier series to solve problems of heat conduction.

5. Systems of First Order Linear Equations
Solve systems of two first order linear equations by transforming them into a single equation of second order
Find eigenvalues and eigenvectors of matrices
Solve systems of first order linear equations using eigenvalues and eigenvectors.

GRADING
- 25 % for each of the two midterms
- 30 % for the final exam
- 10% for written homework
- 10 % for online (Canvas) quizzes

TEXTBOOK (Recommended)
EXAMS, QUIZZES, PAPERS & OTHER MAJOR GRADED WORK
There will be two midterm exams: 2pm - 4pm on Friday July 3 and Saturday, July 25. Please let me know IMMEDIATELY if you have a conflict with these dates. Each exam is 25% of the final grade. The final exam will be from 2pm-4pm on Saturday August 8, 30% of grade.

HOMEWORK & OTHER ASSIGNMENTS

Weekly Problem Sets:
Homework will normally be due on Sunday at 11:59 pm. Homework will be available on-line at the course Canvas site. The homework scores will count for 10% of the grade. The lowest homework score will be dropped.

Online Quizzes:
There will online (Canvas) quizzes that count for 10% of the grade.

RULES, RIGHTS & RESPONSIBILITIES
• See the Guide’s Rules, Rights and Responsibilities

ACADEMIC INTEGRITY
By enrolling in this course, each student assumes the responsibilities of an active participant in UW-Madison’s community of scholars in which everyone’s academic work and behavior are held to the highest academic integrity standards. Academic misconduct compromises the integrity of the university. Cheating, fabrication, plagiarism, unauthorized collaboration, and helping others commit these acts are examples of academic misconduct, which can result in disciplinary action. This includes but is not limited to failure on the assignment/course, disciplinary probation, or suspension. Substantial or repeated cases of misconduct will be forwarded to the Office of Student Conduct & Community Standards for additional review. For more information, refer to studentconduct.wiscweb.wisc.edu/academic-integrity/.

ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES
McBurney Disability Resource Center syllabus statement: “The University of Wisconsin-Madison supports the right of all enrolled students to a full and equal educational opportunity. The Americans with Disabilities Act (ADA), Wisconsin State Statute (36.12), and UW-Madison policy (Faculty Document 1071) require that students with disabilities be reasonably accommodated in instruction and campus life. Reasonable accommodations for students with disabilities is a shared faculty and student responsibility. Students are expected to inform faculty [me] of their need for instructional accommodations by the end of the third week of the semester, or as soon as possible after a disability has been incurred or recognized. Faculty [I], will work either directly with the student [you] or in coordination with the McBurney Center to identify and provide reasonable instructional accommodations. Disability information, including instructional accommodations as part of a student’s educational record, is confidential and protected under FERPA.” http://mcburney.wisc.edu/facstaffother/faculty/syllabus.php

DIVERSITY & INCLUSION
Institutional statement on diversity: “Diversity is a source of strength, creativity, and innovation for UW-Madison. We value the contributions of each person and respect the profound ways their identity, culture, background, experience, status, abilities, and opinion enrich the university community. We commit ourselves to the pursuit of excellence in teaching, research, outreach, and diversity as inextricably linked goals.
The University of Wisconsin-Madison fulfills its public mission by creating a welcoming and inclusive community for people from every background – people who as students, faculty, and staff serve Wisconsin and the world.”
https://diversity.wisc.edu/