MATH 689: Advanced Applied Mathematics II: Ordinary Differential Equations
Spring 2025 Course Syllabus

NJIT Academic Integrity Code: All Students should be aware that the Department of Mathematical Sciences takes the University Code on Academic Integrity at NJIT very seriously and enforces it strictly. This means that there must not be any forms of plagiarism, i.e., copying of homework, class projects, or lab assignments, or any form of cheating in quizzes and exams. Under the University Code on Academic Integrity, students are obligated to report any such activities to the Instructor.

COURSE INFORMATION

Course Description: A practical and theoretical treatment of boundary-value problems for ordinary differential equations: generalized functions, Green's functions, spectral theory, variational principles, and allied numerical procedures. Examples will be drawn from applications in science and engineering.

Number of Credits: 3

Prerequisites: MATH 545 or MATH 645, MATH 613, and MATH 631

Course-Section and Instructors:

Course-Section	Instructor
Math 689-002	Professor M. Booty

Office Hours for All Math Instructors: Spring 2025 Office Hours and Emails

Required Textbook:

There is no required textbook for the course. Reference texts will be suggested in class.

University-wide Withdrawal Date: The last day to withdraw with a **W** is **Monday, April 7, 2025**. It will be strictly enforced.

POLICIES

DMS Course Policies: All DMS students must familiarize themselves with, and adhere to, the Department of Mathematical Sciences Course Policies, in addition to official university-wide policies. DMS takes these policies very seriously and enforces them strictly.

Grading Policy: The final grade in this course will be determined as follows:

Homework	60%
Midterm Exam	15%
Final Exam	25%

Attendance Policy: Attendance at all classes will be recorded and is **mandatory**. Please make sure you read and fully understand the Math Department's Attendance Policy.

Religious Observance: NJIT is committed to supporting students observing religious holidays. Students must notify their instructors in writing of any conflicts between course requirements and religious observances, ideally by the end of the second week of classes and no later than two weeks before the anticipated absence.

Exams: There will be an exam during the semester and a cumulative final exam during the final exam week:

Midterm Exam	TBA
Final Exam Period	May 10 - May 16, 2025

The final exam will test your knowledge of all the course material taught in the entire course. Make sure you read and fully understand the Math Department's Examination Policy. This policy will be strictly enforced.

Makeup Exam Policy: There will be **NO MAKE-UP QUIZZES OR EXAMS** during the semester. In the event an exam is not taken under rare circumstances where the student has a legitimate reason for missing the exam, the student should contact the Dean of Students office and present written verifiable proof of the reason for missing the exam, e.g., a doctor's note, police report, court notice, etc. clearly stating the date AND time of the mitigating problem. The student must also notify the Math Department Office/Instructor that the exam will be missed.

Cellular Phones: All cellular phones and other electronic devices must be switched off during all class times.

Artificial Intelligence: Student use of artificial intelligence (AI) is permitted in this course. However: (i) when used it must be cited clearly following the guidelines at the NJIT Library AI citation page for AI, and (ii) its use is discouraged as a distraction from understanding the course content.

ADDITIONAL RESOURCES

Further Assistance: For further questions, students should contact their instructor. All instructors have regular office hours during the week. These office hours are listed on the Math Department's webpage for Instructor Office Hours and Emails.

Accommodation of Disabilities: The Office of Accessibility Resources and Services (OARS) offers long term and temporary accommodations for undergraduate, graduate and visiting students at NJIT.

If you are in need of accommodations due to a disability please If you need an accommodation due to a disability please contact the Office of Accessibility Resources and Services at oars@njit.edu. The office is located in Kupfrian Hall, Room 201. A Letter of Accommodation Eligibility from the Office of Accessibility Resources and Services office authorizing your accommodations will be required.

For further information regarding self identification, the submission of medical documentation and additional support services provided please visit the Office of Accessibility Resources and Services (OARS) website at:

https://www.njit.edu/accessibility/

Important Dates (See: Spring 2025 Academic Calendar, Registrar)

Date	Day	Event
January 21, 2025	Tuesday	First Day of Classes
January 27, 2025	Monday	Last Day to Add/Drop Classes
March 16, 2025	Sunday	Spring Recess Begins
March 22, 2025	Saturday	Spring Recess Ends
April 3, 2025	Thursday	Wellness day
April 7, 2025	Monday	Last Day to Withdraw
April 18, 2025	Friday	Good Friday - No Classes
April 20, 2025	Sunday	Easter Sunday - No Classes Scheduled
May 6, 2025	Tuesday	Thursday Classes Meet
May 7, 2025	Wednesday	Friday Classes Meet
May 7, 2025	Wednesday	Last Day of Classes
May 8, 2025	Thursday	Reading Day 1
May 9, 2025	Friday	Reading Day 2
May 10 - May 16, 2025	Friday to Thursday	Final Exam Period

Course Outline

Week #	Section #	Subject Topic
1	1	Introduction. Linear two-point boundary value problem for an ODE. Examples. The inner product and adjoint operator.
2-3	2	Introduction to distributions (generalized functions). Test functions. The Dirac delta function. Green's functions. Examples of the use of the Dirac delta function.

4-6	3	General, linear, second order boundary value problems. Solution in terms of the Green's function. Discussion of the role of boundary conditions. Self-adjoint and non self-adjoint problems. Problems of general order. The Fredholm alternative and the modified Green's function. Applications and examples.
7-9	4	General theory of eigenfunction representation. Sturm-Liouville eigenvalue problems and their occurrence in the solution of PDE's. Overview of spectral theory of linear operators. Spectral representation. Eigenfunction expansion of the Green's function and modified Green's function.
10-12	5	The eigensystem of a general non self-adjoint operator. Discrete and continuous spectrum. Singular problems. Applications and examples.
13-14	6	Approximation of eigenvalues and eigenfunctions by variational methods. The Rayleigh-Ritz method. Applications and examples. Further topics.