# MATH 473/573: Intermediate Differential Equations
## *Fall 2025 Course Syllabus*

**NJIT Academic Integrity Code**: Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the academic code of integrity policy that is found at: NJIT Academic Integrity Code.

Please note that it is my professional obligation and responsibility to report any academic misconduct to the Dean of Students Office. Any student found in violation of the code by cheating, plagiarizing or using any online software inappropriately will result in disciplinary action. This may include a failing grade of F, and/or suspension or dismissal from the university. If you have any questions about the code of Academic Integrity, please contact the Dean of Students Office at dos@njit.edu

## COURSE INFORMATION

**Course Description**: Topics in the qualitative behavior of solutions of ordinary differential equations with applications to engineering problems. Includes phase plane analysis, stability, dynamical systems, and chaos. Effective From: Fall 2010.

**Number of Credits**: 3

**Prerequisites**: Math 222 and Math 337 with a grade of C or better.

**Course-Section and Instructors:**

| Course-Section | Instructor |
|---|---|
| Math 473-001 / 573-001 | Professor A. Bose |

**Office Hours for All Math Instructors**: Fall 2025 Office Hours and Emails

**Required Textbook**:

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|---|---|
| **Title** | *Nonlinear Dynamics and Chaos* |
| **Author** | Steven Strogatz |
| **Edition** | 2nd |
| **Publisher** | Westview Press |

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|---|---|
| **ISBN #** | 978-0-8133-4910-7 |
| **Website** | http://www.westviewpress.com |
| **Required Software:** | MATLAB |

**University-wide Withdrawal Date**: The last day to withdraw with a **W** is **Monday, November 10, 2025**. It will be strictly enforced.

## COURSE GOALS

**Course Objectives**

- Gain a deeper understanding of the relevance and the ubiquitous importance of dynamical systems.
- Learn the meaning of new concepts and theory in the qualitative analysis of differential equations.
- Learn how to apply the knowledge of ordinary differential equations and dynamical systems to problems in applied mathematics, science and engineering.

**Course Outcomes**

- Students gain deeper knowledge of the theory and applications of differential equations and dynamical systems, and their broad applicability.
- Students are prepared for further study in more advanced mathematics, science and engineering courses.
- Students can apply their knowledge to solve problems in applied mathematics, fluid dynamics, electrodynamics, and other areas of science and engineering.

**Course Assessment:** The assessment of objectives is achieved through homework assignments and quizzes, and the in-class midterm and final examinations.

## 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:

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|---|---|
| **Homework, Projects and Quizzes** | 50% |
| **Midterm Exams** | 25% |
| **Final Cumulative Exam** | 30% |

Your final letter grade will be based on the following tentative curve.

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|---|---|---|---|
| **A** | 90 - 100 | **C** | 70 - 74 |
| **B+** | 85 - 89 | **D** | 60 - 69 |

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|---|---|---|---|
| **B** | 80 - 84 | **F** | 0 - 59 |
| **C+** | 75 - 79 | | |

**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. This policy will be strictly enforced.

**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.

**Quiz and Homework Policy**: Homework problem sets will be regularly assigned. Notification will typically be given in class. Due dates will be provided at the time of the assignment notification. All homework assignments must be turned in via hard copy. No electronic submissions will be accepted. Late homework will not be accepted. Quizzes may be announced or unannounced. If all students are keeping up with the material, the likelihood of a quiz is very low.

**Projects:** A end of year project may be assigned. If so, details will be provided around the time of the midterm exam.

**Exams**: There will be one midterm exam held in class during the semester and one comprehensive final exam. Exams are held on the following days:

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|---|---|
| Midterm Exam | TBA |
| Final Exam Period | December 14 - December 20, 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.

## ADDITIONAL RESOURCES

**Math Tutoring Center**: Located in the Central King Building, Lower Level, Rm. G11 (See: Fall 2025 Hours)

**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 need an accommodation due to a disability, please contact the Office of Accessibility Resources and Services at oars@njit.edu, or visit Kupfrian Hall 201 to discuss your specific needs. A Letter of Accommodation

Eligibility from the office authorizing student accommodations is 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: Fall 2025 Academic Calendar, Registrar)

| Date | Day | Event |
|---|---|---|
| September 1, 2025 | Monday | Labor Day |
| September 2, 2025 | Tuesday | First Day of Classes |
| September 8, 2025 | Monday | Last Day to Add/Drop Classes |
| November 10, 2025 | Monday | Last Day to Withdraw |
| November 25, 2025 | Tuesday | Thursday Classes Meet |
| November 26, 2025 | Wednesday | Friday Classes Meet |
| November 27 to November 30, 2025 | Thursday to Sunday | Thanksgiving Recess - Closed |
| December 11, 2025 | Thursday | Last Day of Classes |
| December 12, 2025 | Friday | Reading Day 1 |
| December 13, 2025 | Saturday | Saturday Classes Meet |
| December 14 to December 20, 2025 | Sunday to Saturday | Final Exam Period |

# Tentative Course Outline

| Date | Lec | Sections | Topic |
|---|---|---|---|
| | 1 | Chap. 1 | Introduction, Overview, Review |
| | 2 | Chap. 1, 2.0-2.2 | Overview, Review, Stability |
| | 3 | 2.3 – 2.8 | Population Dynamics, Potentials and Numerics |
| | 4 | 3.0 – 3.4 | Saddle-Node, Transcritical & Pitchfork Bifurcations |
| | 5 | 3.4, 3.6, Chap. 4 | Imperfect Bifurcations, Flow on a Circle |
| | 6 | 5.0 – 5.2 | 2D Linear Systems |
| | 7 | 5.0 – 5.2, 6.0 –6.2 | 2D Linear Systems, Phase Portraits |
| | 8 | 6.3 – 6.5 | Fixed Points, Linearization and Lotka-Volterra Eqs. |
| | 9 | 6.5 | Conservative and Hamiltonian Systems |
| | 10 | 6.5 | Conservative and Hamiltonian Systems |
| | 11 | 6.6, 6.7 | Reversible Systems, Pendulum |

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|---|---|---|---|
| | 12 | 6.7 | Structural Stability, Peixoto's Theorem |
| | 13 | 7.0 – 7.2 | Limit Cycles, Lyapunov Functions |
| | 14 | 7.3 | Poincaré -Bendixson Theorem |
| TBA | 15 | ---------- | **MIDTERM EXAM** |
| | 16 | 8.0 – 8.1 | 2D Bifurcations <PROJECT ASSIGN (due 12/9)> |
| | 17 | 8.2-8.3 | Hopf Bifurcation and Applications |
| | 18 | 8.6 | Coupled Oscillators, Quasiperiodicity |
| | 19 | 8.7 | Poincaré Maps |
| | 20 | 9.0 – 9.4 | Lorenz and related Equations |
| | 21 | 10.0 – 10.2 | Cobweb, Logistic Map |
| | 22 | 10.3 – 10.4 | Logistic Map, Sharkovski's Theorem |
| | 23 | 10.5 – 10.6 | Lyapunov Exponents, Universality |
| | 24 | 11.0 – 11.2 | Fractals and Fractal Dimensions |
| | 25 | 11.3 – 11.4 | Fractals and Fractal Dimensions |
| | 26 | 12.0 - 12.1 | Strange Attractors and Smale Horseshoe |
| | 27 | 12.2 - 12.3 | Henon and related Maps <PROJECT DUE> |
| | 28 | ---------- | Term Project Presentations |

*Updated by Professor A. Bose -Aubust 2025*
*Department of Mathematical Sciences Course Syllabus, Fall 2025*