

Fall 2023

MATH 222, Fall 2023: Differential Equations, all sections except for Honors

Mathematical Sciences Department

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THE DEPARTMENT OF MATHEMATICAL SCIENCES

MATH 222: Differential Equations

Fall 2023 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: Methods for solving ordinary differential equations are studied together with physical applications, Laplace transforms, numerical solutions, and series solutions.

Number of Credits: 4

Prerequisites: Prerequisite: **MATH 112** with a grade of C or better or **MATH 133** with a grade of C or better.

Course-Section and Instructors:

Course-Section	Instructor
Math 222-001	Professor M. Potocki-Dul
Math 222-003	Professor M. Potocki-Dul
Math 222-005	Professor Y-N. Young
Math 222-007	Professor C. Turc
Math 222-009	Professor J. Ratnaswamy
Math 222-011	Professor B. Patiak
Math 222-013	Professor J. Ratnaswamy
Math 222-101	Professor J. Ratnaswamy

Office Hours for All Math Instructors: **Fall 2023 Office Hours and Emails**

Required Textbook:

Title	<i>Elementary Differential Equations and Boundary Value Problems</i>
Author	Boyce and DiPrima

Edition	11th
Publisher	John Wiley & Sons, Inc.
ISBN #	978-1119447399

University-wide Withdrawal Date: The last day to withdraw with a W is **Monday, November 13, 2023**. It will be strictly enforced.

COURSE GOALS

Course Outcomes

Students should:

- Learn elementary analytical solution techniques for the solution of ordinary differential equations (ODEs).
- Interpret the solutions using plots and methods of calculus.
- Understand the solution structure of linear ODEs in terms of independent homogeneous solutions and nonhomogeneous solutions.
- Understand, by exposure to examples, how systems and phenomena from science and engineering can be modeled by ODEs, a principal example being the linear spring subject to forcing and damping
- Understand how the solution of such a model ODE can be used to analyze or predict a system's behavior.
- Understand the role of initial value problems for ODEs in examples from science & engineering.
- Understand an elementary method for the numerical solution of ODEs and have some familiarity with the solution of ODEs using MATLAB.
- Be introduced to two-point boundary value problems and Fourier series.

Course Outcomes

- Improved problem-solving skills, including knowledge of techniques for the solution of ODES.
- An understanding of the importance of differential equations in the sciences and engineering
- Preparation for further study in science, technology, engineering, and mathematics.

Course Assessment: The assessment of objectives is achieved through homework assignments, weekly quizzes, and common examinations with common grading.

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	8%
Quizzes	10%
MATLAB Assignments	2%
Common Midterm Exam I	20%
Common Midterm Exam II	25%

Final Exam	35%
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Your final letter grade will be based on the following tentative curve.

A	88 - 100	C	55 - 64
B+	81 - 87	D	45 - 54
B	71 - 80	F	0 - 44
C+	65 - 70		

Attendance: 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. Quizzes and in-class MATLAB activities

Homework: Weekly homework assignments are listed on the course outline. They are to be handed or uploaded on the Canvas in according to your instructor's schedule. Each week, a 15–20 minute quiz will be given on the material covered in the previous week's homework.

Exams: There will be two common midterm exams held during the semester and one comprehensive common final exam. Exams are held on the following days:

Midterm Exam I	October 4, 2023
Midterm Exam II	November 15, 2023
Final Exam Period	December 17 - December 23, 2023

The time of the midterm exams is **4:15–5:40 PM** for daytime students and **5:45–7:10 PM** for evening students. 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: To properly report your absence from a midterm or final exam, please review and follow the required steps under the DMS Examination Policy found here:

- http://math.njit.edu/students/policies_exam.php

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 2023 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 2023 Academic Calendar](#), [Registrar](#))

Date	Day	Event
September 4, 2023	Monday	Labor Day
September 5, 2023	Tuesday	First Day of Classes
September 11, 2023	Monday	Last Day to Add/Drop Classes
November 13, 2023	Monday	Last Day to Withdraw
November 21, 2023	Tuesday	Thursday Classes Meet
November 22, 2023	Wednesday	Friday Classes Meet
November 23 to November 26, 2023	Thursday and Saturday	Thanksgiving Recess - Closed
December 13, 2023	Wednesday	Last Day of Classes
December 14, 2023	Thursday	Reading Day 1
December 15, 2023	Friday	Reading Day 2
December 17 to December 23, 2023	Sunday to Saturday	Final Exam Period

COURSE OUTLINE

Week + Dates	Section # + Topic		Assignments
WEEK 1:	1.1	Some Basic Models; Direction Fields	5, 6, 7, 11, 12, 18
	1.2	Solutions of Some Differential Equations	2, 4, 11
	1.3	Classification of Differential Equations	2, 3, 6, 8, 11
WEEK 2:	2.1	Linear Equations; Integrating Factors	2, 6, 10, 18
	2.1	Integrating Factors (Continued)	23, 24
	2.2	Separable Equations	2, 4, 6, 9, 12
WEEK 3:	2.3	Modeling with First Order Equations	2, 5, 7, 12
	2.7	Numerical Approximation; Euler's Method	2

	MATLAB Project 1		
WEEK 4:	3.1	Homogeneous Equations with Constant Coefficients	2, 6, 8, 10, 13, 16
	3.2	Solutions of Linear Homogeneous Equations and the Wronskian	2, 4, 7, 9, 14, 17, 19, 20, 23
	3.3	Complex Roots of the Characteristic Equation	2, 4, 6, 8, 12, 19
WEEK 5:	3.4	Repeated Roots; Reduction of Order	1, 5, 9, 12, 19
	3.5	Nonhomogeneous Equations; Undetermined Coefficients	2, 4, 8, 13, 14
	REVIEW FOR EXAM 1		
WEEK 6:	3.5	Undetermined Coefficients (Continued)	16(a), 17(a), 21(a)
	3.6	Variation of Parameters	2, 6, 10, 12
	3.7	Mechanical and Electrical Vibrations	1, 3, 4, 6
WEEK 7:	3.7	Vibrations (Continued)	9, 11, 13
	3.8	Forced Vibrations	1, 4, 6
	7.1	System of First Order Linear ODEs	1, 3, 4, 7(a,b)
WEEK 8:	7.2	Review of Matrices	1, 4, 7, 17
	7.3	Review of Linear Algebraic Equations, Eigenvalues, and Eigenvectors (2x2)	15, 16, 17
	7.5	Homogeneous Linear Systems with Constant Coefficients	2(b), 3(b), 5(b), 11
WEEK 9:	7.6	Complex Eigenvalues	1(b), 4(b), 23
	MATLAB Project 2		
	6.1	Definition of the Laplace Transform	3, 5, 10, 12, 19
WEEK 10:	6.2	Laplace Transform Solution of Initial Value Problems	1, 3, 4, 10, 16
	6.3	Step Functions	1, 3, 8, 10, 14, 15
	6.4	ODEs with Discontinuous Forcing Functions	2, 3, 4, 7, 11
WEEK 11:	6.5	Impulse Functions	1, 2, 7
	6.6	The Convolution Integral	4, 5, 8, 9, 14
	5.1	Review of Power Series	15, 17, 18, 19

WEEK 12:	5.2	Series Solutions of Second Order Linear ODEs with Nonconstant Coefficients; Solution Near an Ordinary Point	3(a,b), 5(a,b), 7(a,b)
	5.4	Euler's Equation; Regular Singular Points	3, 6, 12, 17
	REVIEW FOR EXAM 2		
WEEK 13:	5.5	Series Solutions Near a Regular Singular Point, Part I	2, 3
	10.1	Two-Point Boundary Value Problems	1, 3, 5, 14, 15
	10.2	Fourier Series	1, 6, 7, 13, 15
WEEK 14:	10.2	Fourier Series (Continued)	1, 6, 7, 13, 15
	10.4	Even and Odd Functions	19(a,b), 27(a,b)
	REVIEW FOR FINAL EXAM		
WEEK 15:	REVIEW FOR FINAL EXAM		
FINAL EXAM PERIOD: December 17 - December 23, 2023			

Updated by Professor W. Choi - 8/8/2023
Department of Mathematical Sciences Course Syllabus, Fall 2023