

THE DEPARTMENT OF MATHEMATICAL SCIENCES

MATH 222 Honors: Differential Equations - Honors *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: Topics enhance those of Math 222 and concepts are studied in detail. Emphasizes science and engineering applications. Effective From: Fall 2012.

Number of Credits: 4

Prerequisites: MATH 112 H with a grade of B or better or MATH 112 with a grade of A.

Course-Section and Instructors:

Course-Section	Instructor
Math 222-H01	Professor C. Frederick

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 #	WileyPLUS access only: 9781119499619 WileyPLUS access with print text: 9781119499688

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

STUDENT RESPONSIBILITIES

- Read and understand the syllabus
- Adhere to all policies and procedures
- Report conflicts and/or special circumstances in a timely manner
- Report any instances of violations of Academic Integrity to your Instructor
- Communicate directly with your Instructor on ALL course-related matters, including material, procedures, policies and exams.
- Effectively manage time and devote sufficient time to succeeding in this course
- Keep track of your grades
- Make use of all resources available to help you learn
- Be respectful of peers and your instructor
- Accept responsibility for your grades - requests for extra credit opportunities will be denied

COURSE GOALS

Course Objectives

- Students should (a) learn elementary analytical solution techniques for the solution of ordinary differential equations (ODEs), (b) understand the solution structure of linear ODEs in terms of independent homogeneous solutions and non-homogeneous solutions, and (c) interpret the solutions using plots and methods of calculus. Students should (a) understand by exposure to examples how systems and phenomena from science and engineering can be modeled by ODEs, and (b) how solution of such a model can be used to analyze or predict a system's behavior. A key example is the damped, forced, simple harmonic oscillator.
- Students should understand the role of initial value problems for ODEs in examples from science engineering, and should be introduced to the role of two-point boundary value problems and Fourier series.
- Students should understand an elementary method for the numerical solution of ODEs and have some familiarity with the solution of ODEs using MATLAB.

Course Outcomes

- Students have improved problem-solving skills, including knowledge of techniques for the solution of ODEs.
- Students have an understanding of the importance of differential equations in the sciences and engineering.
- Students should be prepared for further study in science, technology, engineering, and mathematics.

Course Assessment: The assessment of objectives is achieved through homework assignments and 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:

Quiz/HW	20%
In class participation	5%
Common Midterm Exam I	15%
Common Midterm Exam II	15%
Common Midterm Exam III	15%
Final Exam	30%

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

A	90 - 100	C	70 - 76
B+	87 - 89	D	60 - 60
B	80 - 86	F	0 - 59
C+	77 - 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.

Quizzes: Quizzes will be given approximately once a week throughout the semester. They will be based on the lecture, suggested problems in the course outline below, homework and the in-class discussions.

Homework: Suggested problems chosen from the text are listed below. Students are recommended to work through these problems after each lecture to gain a better understanding of the course material. Additional problem sets will be assigned during the semester.

In class participation: This course will incorporate inquiry-based learning, which heavily relies on classroom discussions, group work, and informal class presentations. Participation will be assessed for various activities from the Inquiry Oriented Differential Equations (IODE) course notes that will be provided during the semester (these activities are described after the course outline below).

Exams: There will be three midterm exams held during the semester and one comprehensive final exam. Midterm exams will be held during normal class hours on the following days:

Midterm Exam I	Friday, September 22, 2023
Midterm Exam II	Friday, October 20, 2023
Midterm Exam III	Wednesday, November 22, 2023
Final Exam Period	December 17 - December 23, 2023

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 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 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	IODE	Textbook Section # + Topic		Suggested Problems
WEEK 1:	Unit 1: Qualitative and Graphical Approaches	1.1	Some Basic Models; Direction Fields	5, 6, 7, 11, 12, 19
		1.2	Solutions of Some Differential Equations	1, 2, 4, 6, 9, 11, 12
		1.3	Classification of Differential Equations	6(c), 8(c), 10, 11, 13(b,c)
WEEK 2:	Unit 4: Linear Differential Equations	2.1	Linear Equations; Integrating Factors	17, 18, 21, 23, 24, 25
		2.2	Separable Equations	2, 4, 6, 9, 12
	Unit 6-7: Autonomous Differential Equations	2.3	Modeling with First Order Equations	2, 5, 7, 12, 14(a)
WEEK 3:	Unit 13: Second Order Linear ODEs	2.7	Numerical Approximation; Euler's Method	2
		3.1	Homogeneous Equations with Constant Coefficients	3, 5, 6, 8, 10, 13, 15, 16
WEEK 4:	REVIEW FOR EXAM 1			
	EXAM 1			
WEEK 5:		3.3	Complex Roots of the Characteristic Equation	1, 2, 4, 5, 8, 12, 19
		3.4	Repeated Roots; Reduction of Order	1, 5, 7, 9, 11, 12, 19, 22
WEEK 6:		3.5	Nonhomogeneous Equations; Undetermined Coefficients	2, 4, 8, 13, 14
		3.5	Undetermined Coefficients (Continued)	16(a), 17(a), 21(a)
		3.6	Variation of Parameters	2, 6, 7, 9, 10, 12, 13
		3.7	Mechanical and Electrical Vibrations	1, 2, 3, 4, 6, 7
WEEK 7:		3.7	Vibrations (Continued)	9, 11, 12, 13
		3.8	Forced Vibrations	1, 4, 6
	REVIEW FOR EXAM 2			
WEEK 8:	EXAM 2			
		5.1	Review of Power Series	15, 17, 18, 19
		5.2	Series Solutions of Second Order Linear ODEs with Nonconstant Coefficients; Solution Near an Ordinary Point	3(a,b), 5(a,b), 6(a,b), 7(a,b)
		5.4	Euler's Equation; Regular Singular Points	1, 3, 6, 12, 17
WEEK 9:		5.5	Series Solutions Near a Regular Singular Point, Part I	1, 2, 3, 18
		6.1 6.2	Definition of the Laplace Transform and Solution of Initial Value Problems	(6.1) 3, 5, 10, 12, 16, 19, 20, 21, (6.2) 1, 2, 3, 4

		6.2	Initial Value Problems (Continued)	(6.2) 6, 10, 16, 17
WEEK 10:		6.3	Step Functions	(6.3) 1, 3, 5, 8, 10, 12, 14, 15; (6.4) 2, 3, 4, 7
		6.4	ODEs with Discontinuous Forcing Functions	11, 14
		6.5	Impulse Functions	1, 2, 7
WEEK 11:		6.6	The Convolution Integral	4, 5, 7, 8, 9, 14
	Unit 9: Introduction to systems	7.1	System of First Order Linear ODEs	1, 3, 4, 7(a,b)
		7.2	Review of Matrices	1, 2, 4, 7, 17
WEEK 12:		7.3	Review of Linear Algebraic Equations, Eigenvalues, and Eigenvectors (2x2)	14, 15, 16
REVIEW FOR EXAM 3				
WEEK 13	EXAM 3			
	Unit 10: Spring Mass System and Linear Systems	7.5	Homogeneous Linear Systems with Constant Coefficients	2b, 3b, 5b, 10, 11
	Unit 11: Damped and Undamped Linear Systems	7.6	Complex Eigenvalues	1(b), 4(b), 8, 11, 14, 23
	Unit 12: Eigentheory Applied to Linear Systems	10.1	Two-Point Boundary Value Problems	1, 3, 5, 10, 14, 15, 18
		10.2	Fourier Series	1, 5, 6, 7, 13, 15, 16
WEEK 14:		10.2	Fourier Series (Continued)	19(a,b), 20(a,b), 22(a,b)
WEEK 14:		10.4	Even and Odd Functions	2, 3, 4, 7, 9, 15, 16, 21, 23(a,b), 27(a,b)
WEEK 15:	REVIEW FOR FINAL EXAM			
WEEK 16:	Final Exam Period			

Active Learning IODE Activities

Active learning activities based on worksheets from the corresponding units in the IODE text will tentatively occur in weeks 1, 2, 3, and 13. These activities include: Inquiry based discovery; classroom debates; small group discussions; class-wide discussions; and use of graphing technology. Additional active learning activities may be assigned during the semester. These activities would include coding; presentations; projects; and video assignments.