NJIT New Jersey's Science & Technology University

THE COLLEGE OF SCIENCE AND LIBERAL ARTS

THE DEPARTMENT OF MATHEMATICAL SCIENCES

MATH 222: Differential Equations
Fall 2020 Coordinated 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.

DMS Online Exam Policy Fall 2020: Exams will be proctored using both Respondus LockDown Browser+Monitor and Webex. Students will be required to join a Webex meeting from their phone with their cameras on, and to access the exam through LockDown Browser on a Mac or Windows PC with webcam. Students must follow all instructions related to environment checks and camera positioning.

Please be sure you read and fully understand our DMS Online Exam Policy.

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 J. Ratnaswamy
Math 222-003	Professor I. Cohanoschi
Math 222-009	Professor J. Luke
Math 222-011	Professor I. Cohanoschi
Math 222-013	Professor C. Turc
Math 222-017	Professor J. Ratnaswamy
Math 222-023	Professor M. Potocki-Dul
Math 222-029	Professor M. Potocki-Dul
Math 222-101	Professor J. Ratnaswamy

Office Hours for All Math Instructors: Fall 2020 Office Hours and Emails

Required Textbook:

Title	*Elementary Differential Equations and Boundary Value Problems*
Author	Boyce and DiPrima
Edition	11th
Publisher	John Wiley & Sons, Inc.
ISBN #	978-1119447399
Website	https://web.njit.edu/~goodman/courses/math222/

Additional Information: Some review materials are on the course homepage. Exam solutions, and MATLAB help are also posted there.

University-wide Withdrawal Date:The last day to withdraw with a **W** is **Monday, November 9, 2020**. It will be strictly enforced.

COURSE GOALS

Course Objectives

- Students should:
  - learn elementary analytical solution techniques for the solution of ordinary differential equations (ODEs)
  - understand the solution structure of linear ODEs in terms of independent homogeneous solutions and non-homogeneous solutions
  - interpret the solutions using plots and methods of calculus.
- Students should:
  - understand by exposure to examples how systems and phenomena from science and engineering can be modeled by ODEs. A principle example will be the linear spring, subject to forcing and damping.
  - b) understand how the solution of such a model ODE can be used to analyze or predict a system's behavior.
- 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 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	10%
Quizzes	10%
MATLAB Assignments	10%

Common Midterm Exam I	15%
Common Midterm Exam II	15%
Common Midterm Exam III	15%
Final Exam	25%

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

A	88 - 100	**C**	60 - 65
B+	83 - 87	**D**	45 - 59
B	75 - 82	**F**	0 - 44
C+	66 - 74		

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.

Homework Policy and Quiz Policy: Weekly homework assignments are listed on the course outline. They are to be handed 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.

MATLAB Assignments: There will be two MATLAB assignments. Some helpful material is on the course homepage. Math Department MATLAB TAs hold office hours. See here for details.

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

Common Midterm Exam I	September 23, 2020
Common Midterm Exam II	October 21, 2020
Common Midterm Exam III	November 18, 2020
Final Exam Period	December 15 - 21, 2020

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 and put away during all class times.

ADDITIONAL RESOURCES

Math Tutoring Center: Located in the Central King Building, Lower Level, Rm. G11 (See: Fall 2020 Hours)

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 contact Chantonette Lyles, Associate Director of the Office of Accessibility Resources and Services at 973-596-5417 or via email at lyles@njit.edu. The office is

located in Kupfrian Hall, Room 201. A Letter of Accommodation Eligibility from the Office of Accessibility Resources and Services 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 (OARS) website at:

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

Important Dates (See: Fall 2020 Academic Calendar, Registrar)

Date	Day	Event
September 1, 2020	T	First Day of Classes
September 5, 2020	S	Saturday Classes Begin
September 7, 2020	M	Labor Day
September 8, 2020	T	Monday Classes Meet
September 8, 2020	T	Last Day to Add/Drop Classes
November 9, 2020	M	Last Day to Withdraw
November 25, 2020	W	Friday Classes Meet
November 26-29, 2020	R - Su	Thanksgiving Recess - University Closed
December 10, 2020	R	Last Day of Classes
December 11 & 14, 2020	F & M	Reading Days
December 15 - 21, 2020	T - M	Final Exam Period

Course Outline

Week + Dates	Section #	Topic	HW Problem Numbers
WEEK 1: 9/1—9/4	1.1	Some Basic Models; Direction Fields	5, 6, 7, 11, 12, 19
	1.2	Solutions of Some Differential Equations	1, 7 (should say dp/dt), 10
	1.3	Classification of Differential Equations	1, 2, 4, 6, 9, 11, 12
WEEK 2: 9/7—9/11	2.1	Linear Equations; Integrating Factors	6(c), 8(c), 10, 11, 13(b,c), 17, 18, 21, 23, 24, 25
	2.2	Separable Equations	2, 4, 6, 9, 12
	2.3	Modeling with First Order Equations	2, 5, 7, 12, 14(a)
WEEK 3: 9/14— 9/18	2.5	Autonomous Equations and Population Dynamics	2, 4, 6, 8, 10, 11
	2.7	Numerical Approximation; Euler's Method	2
	REVIEW FOR EXAM 1		
WEEK 4: 9/21— 9/25	**COMMON EXAM 1**		
	3.1	Homogeneous Equations with Constant Coefficients	3, 5, 6, 8, 10, 13, 15, 16
	3.2	Solutions of Linear Homogeneous Equations and the Wronskian	2, 4, 5, 7, 9, 14, 17, 19, 20, 21, 23
WEEK 5:	3.3	Complex Roots of the Characteristic Equation	1, 2, 4, 5, 8, 12, 19

9/28—10/2 *Matlab assignment #1 due.*	3.4	Repeated Roots; Reduction of Order	1, 5, 7, 9, 11, 12, 19, 22
WEEK 6: 10/5—10/9	3.5	Nonhomogeneous Equations; Undetermined Coefficients	2, 4, 8, 13, 14, 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: 10/12—10/16	3.7	Vibrations (Continued)	9, 11, 12, 13
	3.8	Forced Vibrations	1, 4, 6
	REVIEW FOR EXAM 2		
WEEK 8: 10/19—10/23	**COMMON EXAM 2**		
	5.1	Review of Power Series	15, 17, 18, 19
	5.2	Series Solutions of Second Order Linear ODEs with Non-constant Coefficients; Solution Near an Ordinary Point	3(a,b), 5(a,b),6(a,b),7(a,b)
WEEK 9: 10/26—10/30	6.1	Definition of the Laplace Transform	3, 5, 10, 12, 16, 19, 20, 21
	6.2	Laplace Transform Solution of Initial Value Problems	1, 2, 3, 4, 6, 10, 16, 17
WEEK 10: 11/2—11/6	6.3	Step Functions	1, 3, 5, 8, 10, 12,14, 15
	6.4	ODEs with Discontinuous Forcing Functions	2, 3, 4, 7, 11, 14
	6.5	Impulse Functions	1, 2, 7
WEEK 11: 11/9—11/13	6.6	The Convolution Integral	4, 5, 7, 8, 9, 14
	7.1	System of First Order Linear ODEs	1, 3, 4, 7(a,b)
	REVIEW FOR EXAM 3		
WEEK 12: 11/16—11/20	**COMMON EXAM 3**		
	7.2	Review of Matrices	1, 2, 4, 7, 17
	7.3	Review of Linear Algebraic Equations, Eigenvalues, and Eigenvectors (2x2)	14, 15, 16
	7.5	Homogeneous Linear Systems with Constant Coefficients	2b, 3b, 5b, 10, 11
WEEK 13: 11/23—11/25	7.6	Complex Eigenvalues	1b, 4b, 8, 11, 14, 23
	10.1 + supplement	Two-Point Boundary Value Problems + Supplement	1, 3, 5, 10, 14, 15, 18 + problems from supplement
	10.2	Fourier Series + Supplement	1, 5, 6, 7, 13, 15, 16
WEEK 14: 11/30—12/4 Matlab assignment #2 due.	10.2	Fourier Series (Continued)	19(a,b), 20(a,b), 22(a,b)
	10.4 + supplement	Even and Odd Functions (plus PDF supplement on Fourier Series for BVP)	2, 3, 4, 7, 9, 15, 16, 21, 23(a,b), 27(a,b) + problems from supplement
	REVIEW FOR FINAL EXAM		
WEEK 15: 12/7-12/10	**REVIEW FOR FINAL EXAM**		
FINAL EXAM PERIOD: DECEMBER 15 - 21, 2020			