MATH 331: Introduction to Partial Differential Equations
Fall 2021 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: Partial differential equations in science and engineering. Topics include initial- and boundary-value problems for parabolic, hyperbolic, and elliptic second-order equations. Emphasis is placed on separation of variables, special functions, transform methods, and numerical techniques.

Number of Credits: 3

Prerequisites: MATH 211 or MATH 213 and MATH 222 all with a grade of C or better.

Course-Section and Instructors:

Course-Section	Instructor
Math 331-001	Professor T. Askham

Office Hours for All Math Instructors: Fall 2021 Office Hours and Emails

Required Textbook:

Title	*Applied Partial Differential Equations*
Author	Richard Haberman
Edition	5th
Publisher	Pearson Prentice-Hall
ISBN #	978-0134995434 (Print) 978-0321905673 (eBook)
Website	Canvas

University-wide Withdrawal Date: The last day to withdraw with a **W** is **Wednesday, November 10, 2021**. It will be strictly enforced.

COURSE GOALS

Course Objectives

- Students will gain a clear intuitive understanding of the concept of a partial differential equation and its relevance to describing physical phenomena such as diffusion and wave propagation.
- Students will gain a deeper understanding of Fourier series by mastering the theory of boundary value problems.
- Students will learn the separation of variables method to solve linear parabolic, elliptic and hyperbolic partial differential equations.
- Students will gain practical knowledge of basic numerical techniques for solving partial differential equations using the finite difference method.
- Students will learn the basics of the spectral Fourier transform method for solving PDEs on an infinite or semi-infinite domain.

Course Outcomes

- Students can derive the heat equation from basic principles such as energy conservation and the Fourier law of heat conduction.
- Students can calculate and visualize Fourier cosine or sine series of a function of one variable.
- Students can find equilibrium solutions to the heat or wave equation and explain their physical meaning.
- Students can write down the complete solution of a linear homogeneous wave, heat or Laplace equation on a rectangular or radially-symmetric domain using separation of variables.
- Students can apply the concept of linearity to solve non-homogenous PDEs by the method of linear superposition.
- Students can solve the heat equation with Dirichlet boundary conditions using the finite difference approach and will develop a basic understanding of computational algorithms that are used to approximate numerical solutions of mathematical problems.
- Students can use the Fourier transform method to solve the heat equation and Laplace's equation in a semi-infinite plane or strip.
- Students have a grasp of the basic principles of Sturm-Liouville theory relating to boundary-value problems.
- Students can use the Rayleigh Quotient to gain information about the lowest eigenvalue and the corresponding eigenfunctions for a boundary value problem.

Course Assessment: The assessment of objectives will be achieved through homework assignments and examinations testing the specific outcomes listed above.

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	25%
Exam 1	20%
Exam 2	20%

Final Exam	35%

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

A	90 - 100	**C**	61 - 67
B+	82 - 89	**D**	52 - 60
B	75 - 81	**F**	0 - 51
C+	68 - 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. Attendance will be taken each lecture and regular attendance is encouraged.

Email and Canvas: Regularly check your NJIT email account and the course information posted on Canvas for class assignments and announcements from your instructor.

Homework: Homework problem sets will be assigned regularly by the instructor via canvas and will include problems requiring basic coding in MATLAB or Mathematica. Due dates as posted on canvas; late work is not accepted (rare exceptions may be made if there is good reason). All HW assignments are to be submitted via the canvas course page (NOT email).

Exams: As of now, all exams will be administered in person. Midterm exams will be held during a regular class meeting; the location and date of the final will be provided to you when they are set.

Exam 1	October 11, 2021
Exam 2	November 10, 2021
Final Exam Period	December 15 - 21, 2021

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 2021 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 are in need of accommodations due to a disability please contact Scott Janz, Associate Director of Disability Support Services at 973-596-5417 or via email at scott.p.janz@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/studentsuccess/accessibility/

Important Dates (See: Fall 2021 Academic Calendar, Registrar)

Date	Day	Event
September 1, 2021	Wednesday	First Day of Classes
September 4, 2021	Saturday	Saturday Classes Begin
September 6, 2021	Monday	Labor Day
September 8, 2021	Wednesday	Monday Classes Meet
September 8, 2021	Wednesday	Last Day to Add/Drop Classes
November 10, 2021	Wednesday	Last Day to Withdraw
November 25 to November 28, 2021	Thursday to Sunday	Thanksgiving Recess - Closed
December 10, 2021	Friday	Last Day of Classes
December 13 and December 14, 2021	Monday and Tuesday	Reading Days
December 15 to December 21, 2021	Wednesday to Tuesday	Final Exam Period

Course Outline

This course will meet MW 11:30am-12:50pm in CKB 124. The first lecture is September 1st and the last lecture is December 8th. There is no class on September 6th (Labor Day).

Lecture / date	Sections	Topic
1 (Sep 1)	1.1-1.3	Introduction: PDEs in physics; derivation of 1D heat equation
2	1.3-1.4	Heat equation: Equilibrium solutions; boundary & initial conditions
3	1.5	Heat equation in higher dimensions
4	2.1-2.2	Linearity & superposition
5	2.3	Method of separation of variables: boundary value problems

6	3.1-3.3	Fourier series review
7	3.4-3.6	Fourier series continued
8	2.4.1-2.4.2	Solving heat equation in 1D rod: insulated ends
9	2.4.2-2.4.3	Solving heat equation in 1D rod: circular ring
10		**Review for Exam 1**
11 (Oct 11)	**Exam 1**	All material covered to date
12	8.1, 8.2	Dealing with non-homogeneous problems
13	2.5.1	Laplace's equation in rectangular domains
14	2.5.2-2.5.4	Laplace's equation: rectangular and circular domains
15	2.5.2-2.5.4	Laplace's equation continued
16	4.1-4.3	Wave equation: 1D derivation with fixed ends
17	4.4-4.5	1D wave equation: Separable solutions & general solution
18	7.1-7.3	2D wave equation: Separable solutions
19	7.1-7.3	2D wave equation; Review for Exam 2
20 (Nov 10)	**Exam 2**	All material covered since Exam 1
Nov 10	**Last Day to Withdraw**	
21	6.1-6.3	Finite difference numerical methods
22	6.1-6.3	Finite difference numerical methods
23	10.1-10.3	Heat equation on an infinite line; Fourier Transform derivation
24	10.1-10.3	Heat equation on an infinite line; Fourier Transform derivation
25	10.4, 10.6	More Fourier Transform problems
26	5.1-5.4	Sturm-Liouville and the Rayleigh Quotient
27	5.6,5.7	Rayleigh Quotient examples
28 (Dec 8)	**Last Class: Final Exam Review**	

Updated by Professor T. Askham - 8/16/2021
Department of Mathematical Sciences Course Syllabus, Fall 2021