MATH 715: ST: Mathematical Fluid Dynamics I
Spring 2024 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.

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

COURSE INFORMATION

Course Description: Introduction to the basic ideas of fluid dynamics, with an emphasis on rigorous treatment of fundamentals and the mathematical developments and issues. The course focuses on the background and motivation for recent mathematical and numerical work on the Euler and Navier-Stokes equations, and presents a mathematically intensive investigation of various model equations of fluid dynamics (e.g., the Korteweg-deVries equations). Effective From: Fall 2005.

Number of Credits: 3

Prerequisites: Departmental Approval

Course-Section and Instructors:

Course-Section	Instructor
Math 715	Professor L. Cummings

Office Hours for All Math Instructors: Spring 2024 Office Hours and Emails

Required Textbook: There is no required textbook for the course. Reference texts will be suggested in class.

University-wide Withdrawal Date: The last day to withdraw with a **W** is **Monday, April 1, 2024**. It will be strictly enforced.

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	40%
Midterm	25%
Final	35%

Your final letter grade will be based on the following boundaries. Note: This grading scale is tentative and serves only as a guide.

A	90 - 100	**C+**	60 - 69
B+	80 - 89	**C**	50 - 59
B	70 - 79	**F**	0 - 49

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. Class attendance and participation can contribute up to 5% of the grade at the instructor's discretion.

Homework: No late homework will be accepted.

Exams: There will be two exams during the semester:

Midterm Exam	Take-home
Final Exam Period	May 3 - May 9, 2024

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 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

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 the Office of Accessibility Resources and Services at oars@njit.edu. The office, located in Kupfrian Hall, Room 201, can provide you with a Letter of Accommodation Eligibility (where appropriate). If you are comfortable doing so, please also contact the instructor directly.

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: Spring 2024 Academic Calendar, Registrar)

Date	Day	Event
January 16, 2024	Tuesday	First Day of Classes
January 22, 2024	Monday	Last Day to Add/Drop Classes
March 10, 2024	Sunday	Spring Recess Begins
March 16, 2024	Saturday	Spring Recess Ends
March 29, 2024	Friday	Good Friday - No Classes
April 1, 2024	Monday	Last Day to Withdraw
April 30, 2024	Tuesday	Friday Classes Meet
April 30, 2024	Tuesday	Last Day of Classes
May 1, 2024	Wednesday	Reading Day 1
May 2, 2024	Thursday	Reading Day 2
May 3 - May 9, 2024	Friday to Thursday	Final Exam Period

Course Outline

Weeks	Subject Topic
1-2	*Introduction and preamble. Modeling of a viscous fluid. Derivation of Navier-Stokes equations using Reynolds Transport Theorem. Some simple exact solutions.*
2-3	*Concepts of scaling and nondimensionalization. Large and small Reynolds number limits. Relevance and limitations. Discussion of boundary conditions (at both rigid and free boundaries).*
3-4	*Flow at high Reynolds number ("inviscid" flow). The Euler equations. Bernouilli's theorem and Kelvin's circulation theorem. 2D inviscid flow around obstacles. Potential flow; existence of streamfunction and complex potential. Flow singularities and method of images for flow with obstacles. Simple theory of flight.*
5-6	*Water waves in 2D irrotational, inviscid flow. Dispersion relations & group velocity.*
7-9	*Viscous boundary layers. Introduction to asymptotic methods for boundary layers. Boundary layer on a flat plate. Boundary layers on more general obstacles.*

9-10	*Flow at low Reynolds number. Flow past circular cylinder: the Stokes paradox. Flow past a sphere.*
11-13	*Lubrication theory: slider bearings, squeeze films, flow with free surfaces.*

Updated by Professor L. Cummings - 12/12/2023
Department of Mathematical Sciences Course Syllabus, Spring 2024