NJIT New Jersey's Science & Technology University

THE COLLEGE OF SCIENCE AND LIBERAL ARTS

THE DEPARTMENT OF MATHEMATICAL SCIENCES

MATH 715: Mathematical Fluid Dynamics I
Fall 2020 Graduate 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: 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-de-Vries equations). Effective From: Fall 2005.

Number of Credits: 3

Prerequisites: Departmental Approval.

Course-Section and Instructors

Course-Section	Instructor
Math 715-001	Professor L. Kondic

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

Required Textbooks:

Title	*(See Recommended Reading Below)*
Author	---
Edition	---
Publisher	---
ISBN #	---
Recommended	• Mathematics Applied to Continuum Mechanics (Dover) by L.A. Segel • Elementary Fluid Dynamics (OUP), by D.J. Acheson.

University-wide Withdrawal Date:The last day to withdraw with a **W** is **Monday, November 9, 2020**. 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 Paper	25%
Final Exam	35%

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.

Exams: The final exam will be held during the following week

Final Exam Week	December 15 - 21, 2020

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

Accommodation of Disabilities: Disability Support Services (DSS) 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 Disability Support 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 Disability Support 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 Disability Support Services (DSS) 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

Weeks	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. Kondic - 8/26/2020
Department of Mathematical Sciences Course Syllabus, Fall 2020