

EGM6812 Fluid Mechanics I - Fall 2021

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Class Time: Monday, Wednesday and Friday 4th Period (10:40am – 11:30am)

Class Location: CSE E107 (on-campus) and Web (online)

Course Description:

Mathematical and physical structures of the Navier-Stokes equation, 1D Exact solutions, Vorticity dynamics, Ideal flow equations and solutions, Waves

Prerequisite: Undergraduate fluid mechanics knowledge

Text: *Class Notes*

Format The lectures for this course are pre-recorder and accessible via Canvas. The schedule of when the lectures must be watched is given below. These lectures **MUST** be watched before class in order to derive benefit. A few classes will be on campus and the most others will be online using zoom through Canvas. The in-class and online zoom sessions will provide additional material intended to offer you the best learning experience.

Grading Policy

Quizzes – 5%, Homeworks – 25%, Mid-Term Exam – 30%, End-of-Term Exam – 40%
A = [90,100], A- = [87,90), B+ = [84,87), B = [80,84), B- = [77,80), C+ = [74,77), C = [70,74), C- = [67,70), D+ = [64,67), D = [60,64), D- = [57,60), E = [0,57).

Quizzes The purpose of the few quizzes is to make sure students have **watched the lectures before class**. To answer them you need to only watch the videos. The harder technical questions are reserved for homeworks. You are not allowed to discuss quizzes, since you must watch the videos yourself. Quizzes must be answered by yourself and must be submitted ontime.

Homework, Final Presentation and Exam Policy

Homework and assignments are due at the beginning of the period on the due date. All assignments should be neat and legible. Points will be taken off for sloppy work. You may discuss the assignments with other students, but you are expect to put in individual effort. Copying and plagiarizing assignments will not be accepted.

Academic Honesty

All students admitted to the UF have signed a statement of academic honesty committing themselves to be honest in all academic work and understanding that failure to comply with this commitment will result in disciplinary action. You are expected to uphold academic honesty and failure to comply will result in disciplinary action.

TA & Office Hours: TA for this course is **Jacob Behrendt** < jbehrendt@ufl.edu >. His office hours are Tuesday and Thursday from 12:00 noon to 1:30 pm. This will be a mix of in-person in PERC Conference room and online (He will announce the modes of contacting him).

Office Hours: Since all the lectures are available over the internet, office hours are essentially the in-class and online sessions. Personal one-on-one office hours can be made upon request.

Recommended Books:

The recommended books are for both Fluid Mechanics I.

Books (1), (2) and (3) are overall good books for this and Fluid-II courses - You could purchase one of them. Books (4) and (5) excellent books as well. They are perhaps harder, but they will be most useful as you become more knowledgeable in fluid mechanics. Book (6) is a very good source from continuum mechanics perspective.

1. *Fundamental Mechanics of Fluids*, by I.G. Currie
2. *Incompressible flow*, by R.L. Panton
3. *Viscous Fluid Flow*, by F.M. White
4. *Introduction to Fluid Mechanics*, by G.K. Batchelor
5. *Fluid Mechanics*, by L.D. Landau & E.M. Lifschit
6. *Stromungsmechanik I in Handbuch der Physik*, by J. Serrin

Course Content

- 1. Introduction
 - Definitions, Continuum Assumption, Definition of Regions
- 2. Cartesian Tensors
 - Definitions & Notation, Vector Transformation Law, Vector & Tensor Algebra/Calculus, Integral Theorems
- 3. Kinematics
 - Lagrangian & Eulerian, Streamlines, Streaklines, Pathlines, Substantial/Material Derivative, Decomposition of Fluid Motion
- 4. Conservation Laws:
 - Reynolds Transport Theorem, Continuity, Momentum, Review of Control Volume Problems, Energy Equations
- 5. Newtonian Fluids and Navier-Stokes Equations:
 - Newton's Viscosity Law Derivation, Stokes Hypothesis, Kinetic Theory Model of Viscosity, Non-Newtonian Fluids, Boundary Conditions, N-S Equations
- 6. Dimensional Analysis
 - Variables and typical scales, Non-dimensional formulation of governing equations, Dynamic similarity, Pi Theorem, Physical interpretation of various Pi groups and various limits
- 7. 1D Exact Solutions for Incompressible Flows
 - Conditions for incompressibility, Exact solutions (channel flow concept of entrance length, fully developed & Couette flow: 1-D approximation for small gap between cylinders)
- 8. Vorticity Dynamics & Bernoulli equation
 - Introduction to vorticity/circulation, Vorticity Equation, Helmholtz's Laws, Kelvin's Theorem, Helmholtz decomposition, Bernoulli equation
- 9. Ideal Flow
 - Streamfunction, velocity potential, Bernoulli's eqn., Properties of Harmonic Functions, Two Dimensional Incompressible Irrotational Flows and Complex Potential, Superposition of flow solutions, Method of images, Flow over an Airfoil, Conformal mapping, Joukowski transformation, Joukowski airfoil
- 10. Three-Dimensional Irrotational Flows
 - General Problems, Axisymmetric Flows, Solutions for Some Simple Flows
- 11. Waves in Incompressible Fluids
 - Basic Equations, Small Amplitude Surface Waves, Velocity field, pathlines, and pressure field, Group Velocity

Lecture Schedule

Week 1	Mon, Aug 23	Lectures 1, 2	Week 4	Mon, Sep 13	Lecture 12
	Wed, Aug 25	Lecture 3		Wed, Sep 15	Lectures 13,14
	Fri, Aug 27	Lecture 4		Fri, Sep 17	Lecture 15
Week 2	Mon, Aug 30	Lecture 5	Week 5	Mon, Sep 20	Lecture 16
	Wed, Sep 1	Lecture 6		Wed, Sep 22	Lectures 17, 18
	Fri, Sep 3	Lectures 7, 8		Fri, Sep 24	Lecture 19
Week 3	Mon, Sep 6	Holiday	Week 6	Mon, Sep 27	Lecture 20
	Wed, Sep 8	Lectures 9, 10		Wed, Sep 29	Lectures 21, 22
	Fri, Sep 10	Lecture 11		Fri, Oct 1	Lecture 23
			Week 7	Mon, Oct 4	Lectures 24

	Wed, Oct 6	Review	Week 12	Mon, Nov 8	Lecture 37
	Fri, Oct 8	Homecoming		Wed, Nov 10	Lecture 38
Week 8	Mon, Oct 11	Exam I		Fri, Nov 12	Lecture 39
	Wed, Oct 13	Lecture 25	Week 12	Mon, Nov 15	Lecture 40
	Fri, Oct 15	Lecture 26		Wed, Nov 17	Lecture 41
Week 9	Mon, Oct 18	Lectures 27, 28		Fri, Nov 19	Lecture 42
	Wed, Oct 20	Lecture 29	Week 13	Mon, Nov 22	Thanksgiving Week
	Fri, Oct 22	Lecture 30		Wed, Nov 24	Thanksgiving Week
Week 10	Mon, Oct 25	Lecture 31		Fri, Nov 26	Thanksgiving Week
	Wed, Oct 27	Lecture 32	Week 14	Mon, Nov 29	Review
	Fri, Oct 29	Lecture 33		Wed, Dec 1	Review
Week 11	Mon, Nov 1	Lecture 34		Fri, Dec 3	Review
	Wed, Nov 3	Lecture 35	Week 15	Mon, Dec 6	Exam II
	Fri, Nov 5	Lecture 36			

Online Course Recording

All the lectures have been recorded and available through Mediasite.

https://ufedge.video.ufl.edu/Mediasite/Catalog/catalogs/fall2019_egm6812

Some of our class sessions may be audio visually recorded for students in the class to refer back and for enrolled students who are unable to attend live. Students who participate with their camera engaged or utilize a profile image are agreeing to have their video or image recorded. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who un-mute during class and participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and communicate exclusively using the "chat" feature, which allows students to type questions and comments live. The chat will not be recorded or shared. As in all courses, unauthorized recording and unauthorized sharing of recorded materials is prohibited.

Attendance Policy, Class Expectations, and Make-Up Policy

It is extremely important that students watch the lecture videos on or before the suggested date in the course schedule. Not watching videos in a timely manner results in poor or mediocre performance. Excused absences at the quizzes and exams must be consistent with university policies in the graduate catalog and require appropriate documentation.

More information on UF grading policy may be found at:

<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#grades>

Students Requiring Accommodations

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting <https://disability.ufl.edu/students/get-started/>. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Course Evaluation

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.aa.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>.

University Honesty Policy

UF students are bound by The Honor Pledge which states, “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” The Honor Code (<https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Commitment to a Safe and Inclusive Learning Environment

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Program Coordinator
- Robin Bielling, Director of Human Resources, 352-392-0903, rbielling@eng.ufl.edu
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

Software Use

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Student Privacy

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <https://registrar.ufl.edu/ferpa.html>

Campus Resources:

Health and Wellness

U Matter, We Care:

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

Counseling and Wellness Center: <http://www.counseling.ufl.edu/cwc>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Discrimination, Harassment, Assault, or Violence

If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the **Office of Title IX Compliance**, located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, title-ix@ufl.edu

Sexual Assault Recovery Services (SARS)

Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

Academic Resources

E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu. <https://lss.at.ufl.edu/help.shtml>.

Career Resource Center, Reitz Union, 392-1601. Career assistance and counseling. <https://www.crc.ufl.edu/>.

Library Support, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring. <https://teachingcenter.ufl.edu/>.

Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers. <https://writing.ufl.edu/writing-studio/>.

Student Complaints Campus: <https://care.dso.ufl.edu>.

On-Line Students Complaints: <http://www.distance.ufl.edu/student-complaint-process>.