

Introduction to Computational Fluid Dynamics
EML 4722 Class #26033, Fall 2020, MWF, Period 7, 1:55 PM – 2:45 PM

Professor

Assistant Professor Sae Miller, Ph.D.
University of Florida Department of Mechanical and Aerospace Engineering
MAE-A 306, Gainesville, FL 32611, PO Box 116250
Preference - please contact through the canvas website <https://ufl.instructure.com>

Office Hours

M & W, 1:55 PM – 3:00 PM, MAE-A 306 via confirmed written appointment

Teaching Assistants

N/A

Course Objectives

This course introduces students to the general theories, numerical algorithms, and processes of computational fluid dynamics. The main objectives are to understand the pre-process that includes the definition of the problem and grid generation, the solver, and the post-process that includes analysis of the results. The students will learn to interpret computational fluid dynamics results and develop skepticism that is balanced by verification and validation techniques. Throughout the course concepts will be illustrated through the use of one popular commercial computational fluid dynamics computer program. The students will have fundamental knowledge of boundary conditions, grid generation, solvers, turbulence modelling, visualization, numerical methods, and a variety of special topics at the termination of the course.

Course Description

Course Catalogue: General theory, skepticism, and practice of computational fluid dynamics. Computational grids and generation, boundary conditions, fluid dynamics, numerical methods, visualization, turbulence modelling, and various special topics.
(Credits 3)

Course Pre-Requisites / Co-Requisites

- EAS 4101 (Aerodynamics) and/or EGN 3353C (Fluid Mechanics), or permission of professor.
- Prefer completion of EAS 4102 (Compressible Flow)

Recommended Textbooks

- Müller, J., `Essentials of Computational Fluid Dynamics,' CRC Pressure, Taylor & Francis Group 2016. ISBN: 978-1-4822-2730-7 (Paperback)
- Ferziger, J. H. and Peric, M., `Computational Methods for Fluid Dynamics,' Springer, 2002.
- Cummings, R. M., Mason, W. H., Morton, S. A., and McDaniel, D. R., `Applied Computational Aerodynamics,' Cambridge, University Press, 2015.
- Tannehill, J. C., Anderson, D. A., and Pletcher, R. H., `Computational Fluid Mechanics and Heater Transfer,' Taylor and Francis, 1997.
- Aref, H. and Balachandar, S., `A First Course in Computational Fluid Dynamics,' Cambridge: Cambridge University Press, 2017. doi:10.1017/9781316823736
- Anderson, J., `Computational Fluid Dynamics,' McGraw-Hill, 1995.
- Various handout material provided digitally by professor.

Materials, Software, and Supplies

- Software – GMSH, SU2, and Paraview (all free and open source). See course website for instructions to obtain software.
- Personal computer (PC) that supports Windows, MAC OSX, or Linux.

Attendance Policy

- It is required that students attend class.

- Required statement by the University of Florida: Excused absences are consistent with university policies in the undergraduate catalog (<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>) and require appropriate documentation.

Class Expectations

- The student is responsible for their education. The professor is the guide to their understanding of the field.

Collaboration

- Homework - Traditional homework problems that should be completed individually.
- Numerical Homework - Homework that uses CFD software and numerics to complete. Students can work together on these assignments. Assignments must be submitted individually.
- Project and Presentation - Students are encouraged to form and work in groups during the group project and presentation.

Policy on Deadlines

- Late submission of class material is not accepted.
- If a tragedy has occurred then instructor notifications are required. See <https://care.dso.ufl.edu/instructor-notifications> for details. Note that, "Professors have the right to accept or reject the notification."

Evaluation of Grades and Grading Policy

Homework

The purpose of homework is to learn and understand the material. Students who turn in fully completed homework will receive 100% credit. Partial solutions of the homework will be posted on the class website after the due date. Students are responsible for understanding the homework problems and solutions. Students will submit solutions of the homework problems only via the course website.

Group Project and Presentation

The students will select a CFD project and perform analysis. They will present the results in the form of a presentation in front of the class at the end of the semester. Please refer to the course website and in class instructions for specific requirements of the group project and presentation.

Grade Corrections

Corrections of grades should be submitted promptly within 3 business days of the grade posting in writing with a concise factual statement of why there has been an error.

Course Grade Evaluation Criteria

- The graded material will be weighted as 0.35 Traditional Homework, 0.35 Numerical Homework, and 0.30 Project.
- The final grade will be assigned on the straight scale: 4.00 (A) → [93.33, 100.00], 3.67 (A-) → [90.00 to 93.33), 3.33 (B+) → [86.67 to 90.00), 3.00 (B) → [83.33 to 86.67), 2.67 (B-) → [80.00 to 83.33), 2.33 (C+) → [76.67 to 80.00), 2.00 (C) → [73.33 to 76.67), 1.67 (C-) → [70.00 to 73.33), 1.33 (D+) → [66.67 to 70.00), 1.00 (D) → [63.33 to 66.67), 0.67 (D-) → [60.00 to 63.33), and 0.00 (E) → [00.00 to 60.00). Final grades are rounded to the nearest hundredths place before assignment.
- At the discretion of the professor, the final course grades will be curved and all students may receive higher grades.

Required Information by the University, College, and Department

Professional Component (ABET):

This course provides analytical, computational, and evaluation of experimental data through individual and team work to communicate analysis of fluid flows.

Relation to Program Outcomes (ABET):

Outcome	Coverage*
1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	High
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	Medium
3. An ability to communicate effectively with a range of audiences	Medium
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	Low
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	Medium
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	Medium
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies	High

Online Course Recording

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.

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.afl.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.afl.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>.