	EML 5725 Computational Fluid Mechanics

Syllabus

Course Information
- **Course Number and Title**: EML5725 Computational Fluid Mechanics
- **Credit Hours:** 3 lecture/0 lab
- **Academic Term:** Spring 2026

Instructor Information
- **Instructor:** Gerardo Carbajal, PhD.
- **Office Location:** BARC-1177
- **Office Hours**: TU-TR 4:00-5:00 PM, W: 11:00 AM-12:00 PM or by appointment.
- **Email address**: gcarbajal@floridapoly.edu

Course Delivery and Course Description

- **Delivery Mode**: In-person attendance
- **Class Meeting Day, Time & Location:** MWF 2:00 PM – 2:50 PM, IST-1026
- **Course Website**: N/A
- **Official Catalog Course Description**: The present course covers finite difference methods and finite volume methods; error and stability analysis; applications to model equations and further developments. Development of governing equations; turbulence modeling; numerical solution of Euler and potential equations, Navier-Stokes equations, and boundary layer equations; and grid generation.
  - **Course Pre and/or Co-Requisites**:
    EGN 3343 Engineering Thermodynamics, EML 3015 Fluid Mechanics, MAC 2313 - Analytic Geometry and Calculus 3, MAP 2302 – Differential Equations.
  - **Communication/Computation Skills Requirement (6A-10.030)**: No.
- **Required Texts:**
  - Computational Fluid Mechanics and Heat Transfer, John C. Tannehill, Dale A. Anderson, Richard H. Pletcher, Fourth Edition, CRC Press, 2020.
    ISBN:978-0815357124.
- **Equipment and Materials:** Only the following calculator models used on the Fundamentals of Engineering (FE) Exam will be allowed for the exams**:**
  - Casio: All fx-115 and fx-991 models (Any Casio calculator must have "fx-115" or "fx-991" in its model name.)
  - Hewlett Packard: The HP 33s and HP 35s models, but no others
  - Texas Instruments: All TI-30X and TI-36X models (Any Texas Instruments calculator must have "TI-30X" or "TI-36X" in its model name

Course Objectives and Outcomes

- **Course Objectives**:
  After successfully completing the course with a grade of B (3.0/4.0) or better, the student should be able to do the following.
- **Course Learning Outcomes**:
  - Recognize the three types of partial differential equations: hyperbolic, parabolic, and elliptic.
  - Apply the finite difference methods or control volume methods to discretize a governing equation.

- Apply numerical methods to selected model equations.
- Apply numerical methods for inviscid flows
- Apply numerical methods for the parabolized Navier-Stokes Equation
- Apply algebraic methods for grid generation.
- Effectively communicate the knowledge of computational fluid mechanics and heat transfer.

University Policies

Reasonable Accommodations

The University is committed to ensuring equal access to all educational opportunities. The Office of Disability Services (ODS), facilitates reasonable accommodations for students with disabilities and documented eligibility. It is the student's responsibility to self-identify as a student with disabilities and register with ODS to request accommodations. If you have already registered with ODS, please ensure that you have requested an accommodation letter for this course through the ODS student portal, and communicate with your instructor about your approved accommodations as soon as possible. Arrangements for testing accommodations must be made in advance. Accommodations are not retroactive. If you are not registered with ODS but believe you have a temporary health condition or permanent disability requiring an accommodation, please contact ODS as soon as possible: DisabilityServices@floridapoly.edu; (863) 874-8770; www.floridapoly.edy/disability.

Accommodations for Religious Observances, Practices and Beliefs

The University will reasonably accommodate the religious observances, practices, and beliefs of individuals in regard to admissions, class attendance, and the scheduling of examinations and work assignments. (See University Policy.)

Title IX

Florida Polytechnic University is committed to ensuring a safe, productive learning environment on our campus that prohibits sex discrimination and sexual misconduct, including sexual harassment, sexual assault, dating violence, domestic violence, and stalking. Resources are available if you or someone you know needs assistance. Any faculty or staff member you speak to is required to report the incident to the Title IX Coordinator. Please know, however, that your information will be kept private to the greatest extent possible. You will not be required to share your experience. If you want to speak to someone who is permitted to keep your disclosure confidential, please seek assistance from the Florida Polytechnic University Ombuds Office, BayCare's Student Assistance Program, 1-800-878-5470 and locally within the community at Peace River Center, 863-413-2707 (24-hour hotline) or 863-413-2708 to schedule an appointment. The Title IX Coordinator is available for any questions to discuss resources and options available.

Academic Integrity

Violations of academic integrity regulation include actions such as cheating, plagiarism, use of unauthorized resources (including but not limited to use of Artificial Intelligence tools), illegal use of intellectual property, and inappropriately aiding other students. Such actions undermine the central mission of the university and negatively impact the value of your Florida Poly degree. Suspected violations will be fully investigated, possibly resulting in sanctions up to and including expulsion from the university.

Recording Lectures

- Students may, without prior notice, record video or audio of a class lecture for a class in which the student is enrolled for their own personal educational use. Recordings may not be used as a substitute for class participation or class attendance. Recordings may not be published or shared in any way, either intentionally or accidentally, without the written consent of the faculty member. Failure to adhere to these requirements is a violation of state law (subject to civil penalty) and the student code of conduct (subject to disciplinary action). Recording class activities including, but not limited to, lab sessions, student presentations (whether individually or part of a group), class discussion (except when incidental to and incorporated within a class lecture), and invited guest speakers is **prohibited**.

Course Policies

Attendance

- Students in **face-to-face (this includes labs and C-courses)** courses are expected "to attend all of their scheduled University classes and to satisfy all academic objectives as defined by the instructor" (University Policy, FPU-5.0010AP).
- Absence does not excuse a student from material covered or any activity done on that day, nor does it extend a deadline.
- Students should inform the instructor as soon as possible if an absence is expected.
- The instructor should be contacted as soon as possible if an absence is due to an unforeseen emergency. Documentation may be required in either case.

Participation

Students are expected to participate in the classroom experience. The use of earbuds/headphones during class is specifically not allowed and students who engage in this behavior may be asked to leave the class for the day (noting exceptions for authorized accommodations). In addition, students who routinely do not bring materials to class that are required for participation, will not be given credit for class attendance, and if this becomes a pattern of behavior, may be asked to leave the class for the day. Persistent problems with participation may result in a code of conduct referral.

Late Work/Make-up work

Makeup is never given for in-class activities/quizzes. Makeup is provided for exams only for exceptional cases after valid documentation is provided.
NO late assignment/project will be accepted.

Grading Scale

This class will apply the following grading scale. *(See also University Grading Policy).*

Grade	Percentage
A	93 - 100
A-	90 - 92
B+	86 - 89
B	83 - 85
B-	80 - 82
C+	76 - 79
C	70 - 75
D	60 - 69
F	0 - 59

Assignment/Evaluation Methods

- **Quiz/In-class activity (5% of the total grade)**
    - Quizzes or in-class activities will occur either in class or through Canvas. No makeup quizzes will be given.
- **Homework (15% of the total grade)**
    - Homework assignments are intended to enhance learning, promote 'habits of mind,' and give students the opportunity to demonstrate what they have learned after the material is covered in class.
    - Homework must be submitted via Canvas as a PDF file by the due date. It is acceptable (and perhaps preferable) that you work on the problems on paper and then use a mobile phone scanner app to convert them into a high-quality PDF. Late homework will not be accepted, and you will receive the minimum grade (zero).
        - Homework should be done independently.

- **Project (15% of the total grade)**

- A course project report must be submitted. The project report must be a complete electronic document (Word or PDF) with paragraphs that explain the problem statement, methodology, results, and discussion, and include relevant figures, tables, and equations.
  - **Exams (2 @ 20% each and Final @20%)**
    - Exams will cover all material covered prior to the class session before the exam. Students are responsible for reviewing all the material and discussing any topics they are concerned about with the instructor during office hours prior to the exam.
    - The two exams during the semester will be scheduled during class hours. The dates and times of exams will be provided as soon as they are known. The final exam will be held during the scheduled final exam period.
  - **Attendance (5% of the total grade)**

Exam Policy: A student missing an exam can only make up for the exam if the student presents <u>satisfactory evidence that his/her absence was unavoidable</u>. It is the duty of the student to notify the instructor before the exam or within twenty-four hours of the time of absence, at which time arrangements will be made for a make-up exam.

An exact percentage of the evaluation method is shown as follows:

Activity	Percentage
Homework	15
Quizzes/In-class activities	5
Project	15
Attendance	5
Exam-1	20
Exam-2	20
Final Exam	20

Grades will be posted to Canvas for reference only; students should ensure they are recorded correctly.
However, there is no guarantee that the percentages or projected grades provided are correct.
The instructor will calculate final percentages and determine final grades regardless of Canvas calculations.

Academic Support Resources
- **Library**: Students can access the Florida Polytechnic University Library through the University website and Canvas, on and off campus. Students may direct questions to library@floridapoly.edu.
- **Tutoring and Learning Center**: The Tutoring and Learning Center (The TLC) provides tutoring to all Florida Poly students who may need additional academic support. The TLC is staffed by students who have excelled in the courses they tutor. They offer support by reviewing concepts and materials from class, clarifying points of confusion and providing assistance with learning strategies. While the focus of TLC is to provide support to students in freshman-level courses, upper-level courses are also tutored at the Center. The TLC is located in the IST Commons (second floor).
  - **Knack Tutoring**: Students looking for additional assistance outside of the classroom are advised to consider working with a peer tutor through Knack. Florida Polytechnic University has partnered with Knack to provide students with access to verified peer tutors who have previously aced this course. To view available tutors, visit floridapoly.joinknack.com and sign in with your student account.
- **Academic Success Coaches**: All students at Florida Poly are assigned an Academic Success Coach. Your Academic Success Coach can assist you with academic success strategies. Please visit the Student Success Center on the second floor of the IST building to meet with an Academic Success Coach.

Writing Center: Located on the second floor of the IST (2059/2061), the Writing Center helps students to develop their writing and presentation skills. Consultations are available in person and virtually. For more detail, visit floridapoly.edu/writing center.

Course Schedule (Tentative)
- Changes in syllabus and assignment sheets may be made as deemed appropriate. All changes will be announced in class and Canvas Announcements.
- Important Dates: https://floridapoly.edu/academics/academic-calendar/index.php

Week	Day	Topic Schedule	Reading

1	2026.01.12	Introduction	Ch 1
	2026.01.14	Partial Differential Equations	Ch 2
	2026.01.16	Partial Differential Equations	Ch 2
2	2026.01.21	Basic Discretization Methods: Finite Difference Method	Ch 3
	2026.01.23	Basic Discretization Methods: Finite Difference Method	Ch 3
3	2026.01.26	Basic Discretization Methods: Finite Volume Method	Ch 3
	2026.01.28	Basic Discretization Methods: Finite Volume Method	Ch 3
	2026.01.30	Stability Considerations	Ch 3
4	2026.02.02	Stability Considerations	Ch 3
	2026.02.04	Applications of Numerical Methods: Wave Equation	Ch 4
	2026.02.06	Applications of Numerical Methods: Energy Equation	Ch 4
5	2026.02.09	Applications of Numerical Methods: Laplace Equation	Ch 4
	2026.02.11	Applications of Numerical Methods: Burger's Equation	Ch 4
	2026.02.13	**Partial Exam#1**	
6	2026.02.16	Fundamentals Equations	Ch 5
	2026.02.18	Fundamentals Equations	Ch 5
	2026.02.20	Average Equations for Turbulent Flow	Ch 5
7	2026.02.23	Average Equations for Turbulent Flow	Ch 5
	2026.02.25	Boundary Layers Equations	Ch 5
	2026.02.27	Boundary Layers Equations	Ch 5
8	2026.03.02	Euler Equations	Ch 5
	2026.03.04	Equations of Convection Heat Transfer	Ch 5
	2026.03.06	Equations of Convection Heat Transfer	Ch 5
9	2026.03.09	Numerical Methods Inviscid Flow Equations	Ch 6
	2026.03.11	Method of Characteristic	Ch 6
	2026.03.13	Classical Shock Capturing Methods	Ch 6
10	2026.03.23	Flux Difference Splitting Schemes	Ch 6
	2026.03.25	**Partial Exam#2**	
	2026.03.27	Introduction to Numerical Methods for Boundary Layer Type Equations	Ch 7
11	2026.03.30	Finite Difference Methods for 2D External Flow	Ch 7
	2026.04.01	Finite Difference Methods for 2D External Flow	Ch 7
	2026.04.03	Methods for Internal Flow	Ch 7
12	2026.04.06	Methods for Internal Flow	Ch 7
	2026.04.08	Introduction to Numerical Methods for The Parabolized Navier-Stokes Equations	Ch 8
	2026.04.10	Thin Layer Navier Stokes Equation	Ch 8
13	2026.04.13	Thin Layer Navier Stokes Equation	Ch 8
	2026.04.15	Parabolized Navier-Stokes Equations: SIMPLE Method	Ch 8
	2026.04.17	Parabolized and Partially Parabolized Navier–Stokes Procedures for Subsonic Flows	Ch 8
14	2026.04.20	Parabolized and Partially Parabolized Navier–Stokes Procedures for Subsonic Flows	Ch 8
	2026.04.22	Parabolized and Partially Parabolized Navier–Stokes Procedures for Subsonic Flows	Ch 8

	2026.04.24	Grid generation	Ch 10
15	2026.04.27	Grid generation	Ch 10
	TBA	**Final exam**	