MAE 550 **Foundations of Fluid Dynamics** Fall 2024

Section: 001/601
Location: EB III, Room 2232
Days: MW
Time: 11:45 am – 1 pm

Instructor: Prof. Tarek Echekki
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Office Hours: Tue 2-4 pm

Text: Pijush K. Kundu, Ira M. Cohen, and David R. Dowling, Fluid Mechanics, 5th or 6th Ed., Academic Press. This is a recommended textbook; it is not required. A link to the electronic version available through the NC State Libraries will be accessible through Moodle.

Prerequisites: MAE 201, 251 or 308 (Undergraduate Thermodynamics and Fluid Mechanics)

Course Objectives: The students will develop an understanding of the foundations of fluid dynamics. Through the study of MAE 550, the student will be able to:

- Develop tools for the characterization of fluid flow;
- Develop the basic equations for the transport of fluids;
- Be able to use these equations and derive simplified forms
- Be able to analyze some basic internal and external flows.

Course Grade:

Homework	20%
Hour Tests (2)	50%
Final Exam	30%

The final grade will be based on the final average and determined as follows:

A- (90 to < 93)	A (93 to < 97)	A+ (97 and above)
B- (80 to < 83)	B (83 to < 87)	B+ (87 to < 90)
C- (70 to < 73)	C (73 to < 77)	C+ (77 to < 80)
D- (60 to < 63)	D (63 to < 67)	D+ (67 to < 70)
F < 60		

Course Syllabus:

Topic	Kundu & Cohen 4th Edition	Kundu, Cohen and Dowling 5th Edition
Introductory concepts	Chap. 1	Chap. 1
Vectors, tensors and integral theorems	Chap. 2	Chap. 2
Kinematics of local fluid motion: Lagrangian and Eulerian descriptions, substantial or material derivatives, decomposition of motion, vorticity, rate of strain, streamline coordinates	Chap. 3	Chap. 3
The Navier-Stokes equations: the stress tensor, differential forms for mass continuity, momentum, energy, angular momentum, second law, vorticity …	Chap. 4, 5	Chap. 4, 5
Variants of the Navier-Stokes equations and approximations (Inviscid: Euler and Bernoulli, Stokes flow, Boussinesq…)	Chap. 4	Chap. 4
Some solutions of the Navier-Stokes equations	Chap. 9	Chap. 8
Boundary layers	Chap. 10	Chap. 9
Special Topics: Turbulence, vorticity , …		

Exams

Test 1	On-campus Section: 9/25/2024 DE Section: The test window is from 9/23/2024 to 9/27/2024
Test 2	On-campus Section: 11/6/2024 DE Section: The test window is from 11/4/2024 to 11/8/2024
Final Exam	On-campus Section: Monday, December 9 from 12:00 pm to 2:30 pm, 2024 DE Section: The test window is from 12/9 to 12/11, 2024 (2.5 hours).

POLICIES AND PROCEDURES

1. There will be two tests and a final examination and frequent homework assignments. All exams will be closed notes, and closed books.
2. Arrangements for missed tests and potential conflicts with exam times or windows are made on an individual basis provided there is an acceptable, certifiable excuse.
3. Students are highly encouraged to do homework problems as assigned. The following procedure is recommended when attempting homework problems as well as for all solutions on tests and exams.
   - State the problem and draw the appropriate system or control volume if possible.
   - State clearly the assumptions you make and state the basic equations you use.
   - Show all the steps needed to find your final answer.
   - If you present a graph as part of a solution, label the axes and the curve; include the units, and choose a scale that can be easily interpolated. Regardless, please do not plot graphs by hand (I do get that occasionally!).
   - Place your final answer or conclusion in a box so that it stands out.