

Plan

AE 225 – Incompressible Fluid Mechanics

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Contact

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- Office hours: By appointment made by email at least 2 hours prior

Topics

1. Introduction to fluid mechanics
2. Fluid properties and fluid forces
3. Classification of fluid flows
4. Fluid statics
5. Kinematics of fluid flows: Lagrangian & Eulerian descriptions
6. Equation of motion in differential form
7. Streamline, pathline and streakline; dilation strain rate; circulation and vorticity; Bernoulli's equation
8. Examples of conservation of mass, momentum and energy in fixed, deforming and moving control volumes
9. Navier-Stokes equation

Topics (contd.)

10. Similitude, dimensional analysis and modeling; important non-dimensional groups in fluid mechanics
11. Potential flow, Stream function, Velocity potential, Source, Sink, Doublet, Vortex
12. Mean flow equation: Reynolds averaging & Reynolds stresses
13. External flows: boundary layer theory, wake and drag
14. Internal flows: viscous flows with exact solutions, pipe flow
15. Introduction to turbulence

Course material

Textbooks:

- Munson, Young, Okiishi & Huebsch, *Fundamentals of Fluid Mechanics*, 6th ed., Wiley, 2009
- Cengel, Y. A. & Cimbala, J. M., *Fluid Mechanics (Fundamentals and Applications)*, 3rd ed., McGraw Hill, 2014
- White, F. M., *Fluid Mechanics (SI Units)*, 7th ed., McGraw Hill, 2011
- Panton, R. L., *Incompressible Flow*, 3rd ed., Wiley India Edition, 2006

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Course will be taught using chalk-board, primarily from first textbook

However, slides that are already prepared from an earlier delivery will be made available on moodle

Do NOT rely solely on slides – use all the textbooks to the fullest

Attendance Policy

Attendance is **compulsory**

- IITB attendance policy for the students will be strictly followed
- There will be 5 marks for attendance in the final grade
- Students whose attendance is below 80% of the total no. of classes will not get any marks in this; others will get full marks

Attendance will be taken in the **first 3 minutes** of class

Students entering later than **3 minutes** will be marked absent (no excuses!)

Evaluation

Test	%
Quiz 1	10
Quiz 2	10
Mid-semester exam	25
Quiz 3	10
Attendance	5
End-semester exam	40

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Quizzes:

- Each quiz will be of 40 minutes
- Quizzes will be conducted in the last 40 minutes of normal classes

Grading policy

Your score will be first normalized with the highest score

AA: 100 – 90, AB: 90 – 80, BB: 80 – 70, BC: 70 – 60,
CC: 60 – 50, CD: 50 – 40, DD: 40 – 35, FR: Below 35

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Note:

- The above assumes that actual score of at least one student is ≥ 85
- If not, then no one will be given an AA grade.
- Scores will be normalized as: $\text{score} = (\text{your_actual_score}) \times 90/85$.
- Letter grades then will be assigned based on the split given above.

Advisory

Warning!

- AE 225 is one of the bedrock courses of the department
- It serves as the prerequisite for several subsequent core courses
 - AE 236: Compressible Fluid Mechanics
 - AE 333: Aerodynamics
 - AE 332: Aircraft Design
 - AE 312: Aerodynamics Laboratory
 - AE 316: Aerospace Propulsion Laboratory
- If you fail this course, then all the subsequent ones will be held up
- At worst, this can delay your graduation
- At best, it will create havoc in your academic career

AE 216 – Concurrent 8-credit course

- Also covers topics in compressible fluid mechanics (self-study)
- 2 extra homework assignments for 10 marks each (also covering compressible fluid mechanics)
- Remaining assessment same as for AE 225, but scaled to 80%

Test	%
Quiz 1	8
Quiz 2	8
Homework assignment 1	10
Mid-semester exam	20
Quiz 3	8
Homework assignment 2	10
Attendance	4
End-semester exam	32

Attendance policy very much in effect!