

ME 1015 Aerodynamics & Flight Performance

Instructor: Jangho Yoon, Ph.D
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Office hours: Tue Wed & Thu: 05:00 – 06:00 PM, or by appointment
Class time: Mon: 08:15 - 11:00 AM
Class location: Liberal Art Building Zone 2 Room # 106

Catalog Description: This class is an introduction to theoretical aerodynamics. Primary focus will be on incompressible flows over two- and three-dimensional bodies. Topics to be covered are potential flow theory, airfoil theory, finite wings, viscous flows, and flight performance. (3 credit hours)

Course Objective The aim of this course is to:

- Review the fundamental principles of Fluid Mechanics
- Determine aerodynamic forces and moments on airfoil, wing and body of revolution in subsonic flow.
- Analyse boundary layer: velocity profile, thickness and friction coefficient.
- Determine basic aerodynamic characteristics of an airfoil and a wing.
- Apply presented numerical implementations to basic elements of aircraft configurations.

Prerequisites: *ME-0071 Introduction to Fluid Mechanics* or Instructor's Permission

Textbook: J. D. Anderson, Jr. *Fundamentals of Aerodynamics*. Sixth Edition. McGraw-Hill. 2017.

Reference: John J. Bertin and Russell M. Cummings. *Aerodynamics for Engineers*. Sixth Edition, Pearson, 2013.

Topics Covered:

1. Lift, drag, moment and related coefficients; conservation equations; Streamlines, streaklines and pathlines; Velocity potential and stream function
2. Bernoulli's equation; Elementary flows (uniform, sources, sinks and vortex);
3. Ideal lifting flow past a circular cylinder, Kutta-Joukowski theorem and lift generation; source panel method for non-lifting flows; d' Alembert's paradox.
4. Kutta Condition; Thin airfoil theory; Aerodynamic center; Vortex panel method for lifting flows
5. Downwash and induced drag; Biot-Savart Law and Helmholtz's Theorems;
6. Prandtl's lifting line theory; Numerical lifting-line method.

Grading Breakdown

Attendance	5%
Weekly Homework	10 %
Project	10 %
Mid Term Exams	35 % (Oct 24)
Final exam	40 % (Final Week)

Grading Scale

While grades may be curved, there is no guarantee of any curve. However, in order to receive a grade of D or better, a student will have to reach 50 % of the total possible points. The grading scale is

A \geq 90%		A ⁻ \geq 85%
B ⁺ \geq 80%	B \geq 76%	B ⁻ \geq 73%
C ⁺ \geq 70%	C \geq 66%	C ⁻ \geq 63%
D ⁺ \geq 61%		D \geq 60%

Homework, Class notes and Exams

There will be homework assigned on weekly base, and it must be submitted to Black Board on time. **Homework must be handwritten otherwise there will be 50% penalty. Late homework will be accepted with 40% penalty for the first 12 hours delay, 75% for the next 12 hours and 100% for thereafter** unless an arrangement is made with the instructor well ahead of the due date. One lowest homework scores will be dropped from your grade at the end of semester.

There will be **one term exam** and **one final exam**. The final exam will be comprehensive. The exams in this course will be closed book and closed note.

If you miss any exam, NO make-up will be given for the missing exam *without prior arrangement*. If you have a serious conflict with an exam time, you **MUST** discuss it with the instructor **BEFORE** the scheduled day for the exam to make an appropriate arrangement. Exams missed due to unpredictable events such as a family emergency and a traffic accident will be dealt with on a case-by-case basis if the student has a proper document(s) to prove it

Students have one week after the any graded work including exams is returned and/or the grad of a work is posted on BB to dispute the grade.

It is important that you show the work in an organized manner clearly showing your thought process in solving the assigned problems. Instructor cannot give credits for the answer(s) that is(are) not readable and/or understandable.

All assigned problems must be solved **with appropriate units**. Otherwise, you will be penalized for any missed unit or wrong unit. You will also be penalized for using an excessive number of significant figures.

e.g., $\pi = 3.1415926535897932385$ instead of $\pi = 3.14$.

Collaboration:

Collaboration between students is strongly encouraged for better understanding of the course material. Students are allowed to discuss homework problems and projects in terms of **methodologies**, but **not the solutions** of a problem, which means that each student **MUST** do the actual work independently. Inappropriate collaboration (also known as cheating) includes

- Using all or parts of homework, exams or projects from this year or any previous year
- Sharing of work such as graphs, equations, calculations or any other derived material that was not presented to the class
- Talking, passing information or using inappropriate materials during an exam Anyone found to be participating in inappropriate collaboration may be immediately failed from the course.

Office Hours:

Office hours are times I have specifically set aside to be available to students. During office hours, you can come to my office; you don't need an appointment. I may be available at other times; please email to schedule a time. Current office hours will be posted on the class website.

Be prepared to show me what work you have already done!

Attendance:

On-time attendance at all class activities is expected. Attendance itself will be the part of graded, and the students are responsible for any material that was covered such as any changes to the exam dates and homework assignments announced in class. Make-up work will only be accepted if prior arrangement has been made or if a valid emergency excuse (e.g., meteor strike) is accompanied by appropriate documentation.

Other Policies:

Please honor the following: do not come late; do not disturb the class by having conversation with others; do not work on any class materials.

Those students who fail to follow these policies may be asked to leave the class.

The instructor also reserves the right to extend credit for alternative assignments, projects, or presentations, and to make changes to this syllabus as needed.

All changes will be announced via Blackboard and/or in class