San José State University
College of Engineering / Aerospace Engineering
AE 160, Aerodynamic I, Section 03, Fall 2020

Course and Contact Information

Instructor(s):	Brian Andrade
Office Location:	Online
Telephone:	(408) 964-0513
Email:	Brian.andrade@sjsu.edu
Office Hours:	Monday and Wednesday, 17:45-18:45 & by appointment
Class Days/Time:	Monday and Wednesday, 16:30-17:45
Classroom:	Online, Zoom meeting, See Canvas for links
Prerequisites:	Grade of C or better in MATH 31 (or MATH31X) and PHYS 50, or graduate standing Corequisite of ENGR 100W

Course Description

Introduction to incompressible, inviscid and viscous aerodynamics through problem solving, computer simulations, water and wind-tunnel experiments, films, and service learning. Topics include aerodynamic forces and moments, flow classification and similarity, conservation laws with applications in the calculation of lift and drag, and boundary layer theory with emphasis on calculation of skin friction and pressure drag.

Course Format

Online Course

This course is an online course and all materials shall be conveyed via Canvas with the course lectures conducted via Zoom. Some materials may be provided by means of a free service outside of Canvas, in such case a link to the material shall be made available on Canvas along with notice of what the material is. This course will require internet connectivity to access these course materials on Canvas and elsewhere as well as to participate in the Zoom lectures. For participation in the zoom lecture a microphone connected to your computer is preferable but not required.

Program Information

This class is administered in support the Bachelor of Science in Aerospace Engineering and Master of Science in Aerospace Engineering degree programs for the Aerospace Engineering Department. For any questions regarding the programs or department please refer to the Aerospace Engineering Department webpage (www.sjsu.edu/ae) or office (Engineering building, room 272)

Course Goals

Introduce students to:

A. Modeling of low speed, viscous and inviscid flows.
B. Calculation of aerodynamic forces on aerospace and ground vehicles.
C. Aerodynamic design for low drag.
D. Water and wind tunnel testing.

Course Learning Outcomes (CLO)

Upon successful completion of this course, students will be able to:

1. Explain the nature of aerodynamic forces.
2. Define the aerodynamic center and the center of pressure for an airfoil.
3. Calculate aerodynamic forces and moments on bodies by integrating surface pressure and shear stress distributions.
4. Use flow similarity to design wind tunnel tests.
5. Classify a flow as 1-D, 2-D or 3-D, uniform / non-uniform, viscous / inviscid, compressible / incompressible, steady / unsteady, subsonic, transonic, supersonic or hypersonic.
6. Design and perform flow visualization tests to study the characteristics of the flow around 2-D and 3-D aerodynamic bodies and analyze the results from such experiments.
7. Use the momentum equation to calculate (a) lift from given pressure distributions on the top and bottom of an aerodynamic body and (b) drag from given velocity profiles ahead and downstream of an aerodynamic body.
8. Describe qualitatively and quantitatively laminar and turbulent boundary layers in terms of thickness, velocity profiles, and shear stress variation.
9. Predict transition from laminar to turbulent flow on an aerodynamic surface.
10. Calculate the skin friction drag and estimate the pressure drag of aerodynamic bodies.
11. Predict location on an airfoil surface and inside a nozzle, where boundary layer separation is likely to occur.
12. Design and perform wind tunnel experiments to measure the drag of a 2-D aerodynamic body and analyze the results from such experiments.
13. Design and perform wind tunnel experiments to study boundary layer characteristics on an aerodynamic surface and analyze the results from such experiments.
14. Work effectively in teams to (a) define and solve open-ended aerodynamics problems, (b) design and perform water / wind tunnel experiments, and (c) analyze and present results from such experiments.

Course Relationship to BSAE Program Outcomes

	1	2	3	4	5	6	7
Learning Objectives							
1 – 5, 7 – 11	++						
6, 12, 13, 14			+++		+++	+++	+++

+: Skill level 1 or 2 in Bloom's Taxonomy
++: Skill level 3 or 4 in Bloom's Taxonomy
+++: Skill level 5 or 6 in Bloom's Taxonomy

Required Texts/Readings

Textbook

John D. Anderson, Jr.'s Fundamentals of Aerodynamics (5th Edition) is RECOMMENDED but not mandatory
ISBN: 978-0-07-339810-5

Available from common online retailers.

NOTE: Any edition of the book is acceptable. Instructor shall be referring to the 5th edition but relevant material difference between editions is minimal

Other Readings

Course slides (available on Canvas shortly after the respective lecture)

Course Requirements and Assignments

Success in this course is based on the expectation that students will spend, for each unit of credit, a minimum of 45 hours over the length of the course (normally three hours per unit per week) for instruction, preparation/studying, or course related activities, including but not limited to internships, labs, and clinical practica. Other course structures will have equivalent workload expectations as described in the syllabus.

This course shall have quizzes (5), assignments (~12), labs (4), and the final exam contribute to the final overall grade. The numbers of respective components (excepting the final exam) is subject to change as circumstances may change.

Quizzes shall be open book and open note, given synchronously during a normally schedule course time, and be submitted to Canvas by the specified time.

Assignments shall be completed individually (though collaboration is encouraged) and submitted per the schedule on Canvas.

Labs shall be completed in groups of not more than 4 and submitted per the schedule electronically on Canvas. Any issues regarding fair participation in the lab or completion of respective reports should be addressed as soon as feasible prior to the submission of the report. Provisionally labs shall be available in person however there shall be arrangements made for those who cannot feasibly attend an in-person lab.

Final Examination or Evaluation

This course shall have a final cumulative exam which shall be given synchronously per the university final schedule on December 9th 2020 from 1445-1700.

Grading Information

Grade Categories and contribution to total grade:

Homework	20%
Quizzes	30%
Final Exam	20%
Lab Reports	30%

Grade	*Percentage*
A plus	*95 to 100%*
A	*90 to 95%*
A minus	*85 to 90%*
B plus	*80 to 85 %*
B	*75 to 80%*
B minus	*70 to 75%*
C plus	*67 to 70%*
C	*65 to 67%*
D	*60 to 65%*
F	*59.9% or lower*

Late work shall at the discretion of the instructor be penalized by up to 20%. No late work shall be accepted after two weeks from the original due date. Absence during a quiz or final shall result in a zero for the score unless a suitable makeup can be mutually determined between the instructor and student.

Classroom Protocol

Class shall be held via zoom meeting. It is encouraged to have a microphone for the purposes of asking questions, questions in text chat may go un-noticed accidentally. Microphones should be muted unless in active and deliberate use, to minimize background noise.

University Policies

Per University Policy S16-9 *(http://www.sjsu.edu/senate/docs/S16-9.pdf)*, relevant university policy concerning all courses, such as student responsibilities, academic integrity, accommodations, dropping and adding, consent for recording of class, etc. and available student services (e.g. learning assistance, counseling, and other resources) are listed on Syllabus Information web page (http://www.sjsu.edu/gup/syllabusinfo), which is hosted by the Office of Undergraduate Education. Make sure to visit this page to review and be aware of these university policies and resources.

AE160 / Aerodynamics I, Fall 2020, MW 1630-1745

Course Schedule

Week	Date	Topics
1	08/19	Introduction to fluids, density, pressure, viscosity.
1	08/24	"
2	08/26	Aerodynamic forces and moments
2	08/31	"
3	09/02	Aerodynamic forces and moments.
4	09/09	Aerodynamic coefficients. Center of pressure. Aerodynamic center.
4	09/14	"
5	09/16	Flow similarity. Application in wind tunnel testing.
5	09/21	"
6	09/23	Flow description. Streamlines. Flow classification
6	09/28	'
7	09/30	Continuity. Flow quality. Wind tunnel design.
7	10/05	'
8	10/07	Bernoulli. Airspeed measurement. Airfoil pressure distributions.
8	10/12	"
9	10/14	Momentum equation.
9	10/19	"
10	10/21	Drag calculation for 2-D bodies
10	10/26	'
11	10/28	Boundary layers: qualitative description
11	11/2	"
12	11/4	Laminar boundary layers: thickness, velocity and shear stress distribution
12	11/9	'

Week	Date	Topics
13	11/16	Turbulent boundary layers: thickness, velocity and shear stress distribution.
13	11/18	“
14	11/23	Skin friction and pressure drag calculation
14	11/25	“
15	11/30	Boundary layer transition and separation –Boundary layer control
15	12/2	“
16	12/7	Final Review
Final Exam		Online, December 9th 2020, 1445-1700

This schedule is subject to change as circumstances develop and notice of any change shall be delivered via Canvas announcement for quizzes and exams. Changes regarding the topic schedule or assignments will generally be made by canvas announcement but may be communicated during normally scheduled lecture for minor changes.