San José State University
Aerospace Engineering
AE160 Aerodynamics, Fa11 2016

Instructor:	Prof. Rachael V. Ishaya
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Office Hours:	Tues & Thurs after class or by appointment
Class Days/Time:	Tues & Thurs / 10:00 – 11:15 am
Classroom:	E164
Prerequisites:	MATH 032, PHYS 050 (with a grade of 'C-' or better in each) or graduate standing. Co-requisite: ENGR 100W

Faculty Web Page and MYSJSU Messaging

Course materials such as syllabus, handouts, notes, assignment instructions, etc. can be found on my faculty web page at http://ae.sjsu.edu/profile/rachael-ishaya and/or on the Canvas Leaning Management System course login website at http://sjsu.instructure.com. You are responsible for regularly checking with the messaging system through MySJSU at http://my.sjsu.edu.

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 Goals

Introduce students to:

- *Modeling of low speed, viscous and inviscid flows.*
- *Calculation of aerodynamic forces on aerospace and ground vehicles.*
- *Aerodynamic design for low drag.*
- *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

	A	B	C	D	E	F	G	H	I
Learning Objectives									
1 – 2	+								
3 – 4,	++								
5	+++	+++							
6, 12 – 13		+++		✓	✓			++	+++
7 - 11	++								
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
✓ Skill addressed but not assessed

Required Texts/Readings

Textbook

Anderson, J.D., Fundamentals of Aerodynamics, 6th edition, ISBN 978-1-259-12991-9

Other Readings

Instructor Notes

Course Requirements and Assignments

Lab Experiments

You will design and perform in teams - no more than 4 people - 4 experiments in the aerodynamics lab (Engr. 107): one flow visualization experiment in the water tunnel and three experiments in the subsonic wind tunnel. Each experiment takes approximately 2 hours. A lab report is due for each experiment, following the posted guidelines1, two weeks after you complete the experiment. You must earn a minimum of 140 points total in your lab reports to receive a passing grade in the course.

Service Learning Project

You will work in teams – no more than 4 people – to define a Service Learning Project. You are encouraged to integrate theory and applications from other courses. Progress reports are due every 2 weeks throughout the semester. You are expected to demonstrate your concept at the end of the semester to elementary school kids at an after school program at the Third Street Community Center in San José (http://www.3street.org/) as well as at San Jose High School.

Final Examination or Evaluation

- *You must average at least 60% on your tests (quizzes and final) to receive a passing grade in the course ("C –", "C" or "C +"). If you average 60% - 69% on your tests you can only earn a "C –", "C" or "C +" in the course, regardless of the total number of points you may have earned.*

- *You must average at least 70% on your tests (quizzes and final) to receive an A or a B in the course.*

Grading Information

Workouts	*100 points*
Quizzes	*300 points*
Final Exam	*200 points*
Project	*200 points*
Lab Reports	*200 points*

Total 1000 points
950 points < A+
900 points < A
850 points < A-
800 points < B+
750 points < B
700 points < B-
670 points < C+
650 points < C
600 points < D
Below 600 points = F

University Policies

Per University Policy S16-9, university-wide policy information relevant to all courses, such as academic integrity, accommodations, etc. will be available on Office of Graduate and Undergraduate Programs' Syllabus Information web page at http://www.sjsu.edu/gup/syllabusinfo/.

AE Department and SJSU policies are also posted at http://ae.sjsu.edu/program-policies.

Course Schedule

Week	Date	Topics, Readings, Assignments, Deadlines
1	8/30 & 9/1	Introduction to fluids. Density, pressure, viscosity.
2	9/6 & 9/8	Newton's law of viscosity: calculation of viscous forces.
3	9/13 & 9/15	Aerodynamic forces and moments.
4	9/20 & 9/22	Aerodynamic coefficients. Center of pressure. Aerodynamic center.
5	9/27 & 9/29	Flow similarity. Application in wind tunnel testing.
6	10/4 & 10/6	Flow description. Streamlines. Flow classification ***Water tunnel experiment: Identify flow characteristics, classify flows.***
7	10/11 & 10/13	Continuity. Flow quality. Wind tunnel design.
8	10/18 & 10/20	Bernoulli. Airspeed measurement. Airfoil pressure distributions. ***Wind tunnel experiment 1: Flow quality, calibration of the test section.***
9	10/25 & 10/27	Momentum equation.
10	11/1 & 11/3	Drag calculation for 2-D bodies. ***Wind tunnel experiment 2: Airfoil wake traverses – drag calculations.***
11	11/8 & 11/10	Boundary layers: qualitative description – Video.
12	11/15 & 11/17	Laminar boundary layers: thickness, velocity and shear stress distribution. ***Wind tunnel experiment 3: Flat plate boundary layer studies.***
13	11/22	Turbulent boundary layers: thickness, velocity and shear stress distribution.
14	11/29 & 12/1	Skin friction and pressure drag calculation
15	12/6 & 12/8	Boundary layer transition and separation – Boundary layer control – Video.
16	12/13 & 12/15	Service learning project demonstrations
Final Exam	Tuesday, December 20	ENGR 164 at 9:45 am – 12:00 pm