AEM 313
Aerodynamics

Instructor: Dr. James P. Hubner
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Office Hours: TR 1:30 – 3:00 pm or by appointment

Lecture Hours: MWF 1:00 pm – 1:50 pm, SERC 1059

Credit Hours: 3

Requisites: MATH 238, AEM 264, AEM 311

Required Text: Bertin, JJ, and RM Cummings, *Aerodynamics for Engineers,* 6th ed., ISBN-13: 978-0-13-283288-5 (hard copy or e-text). Another good reference text (not required) is *Fundamentals of Aerodynamics* by JD Anderson.

Web Page: Blackboard will be used as the class web portal. Log in to http://ualearn.blackboard.com with your myBama account information and select **201540-AEM-313-001.** Course documents, HW assignments, lecture material and other material will be posted on this site. **For technical questions regarding Blackboard Learn, contact the Office of Information Technology at 348-3532.**

Description: Aerodynamics is a survey of subsonic aerodynamics. Topics include aerodynamic forces and moments, airfoils and wings, conservation equations, flow kinematics, potential flow, thin airfoil theory, lifting-line theory, boundary layers and subsonic compressible flow. The follow-on course, Compressible Flow (formerly Aerodynamics II) will focus on compressible aerodynamics, primarily supersonic flow. Together these courses will provide the foundation for upper level undergraduate and first year graduate courses such as propulsion, flight mechanics, gas dynamics and experimental aerodynamics.

Learning Goals: Students completing Aerodynamics should be able to

- understand basic aerodynamic terminology,
- determine aerodynamic forces and moments over airfoils based on pressure and shear stress distributions,
- apply control volume techniques to estimate external forces,
- apply potential flow theory to basic two dimensional shapes to determine the velocity field, surface pressure and resultant force,
- apply thin-airfoil and lifting-line theory to estimate airfoil and wing characteristics,
- calculate and assess the characteristics of laminar and turbulent boundary layers, and
- understand the limits of incompressible flow theory and apply subsonic compressible flow corrections when necessary.

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Class Policies:

Lecture: Attendance and on-time arrival is expected. **Reading assignments are to be completed prior to class**. Students are responsible for all scheduling and policy announcements made in class. Power-off or silence electronic items that can disturb the lecture or distract your or your neighbor's attention.

Homework: Homework assignments consisting of end-of-chapter problems will be posted periodically on Blackboard and announced in class. These HW assignments will not be collected or graded but the material will be tested. Two or three projects encompassing a larger scope of work and requiring the use of computer programming (e.g. MATLAB) will be assigned and collected.

Exams: Three hourly exams and one final exam will be administered. Exams will cover both text and lecture material. If you have a scheduled event which prevents you from taking an exam, contact me during the first two weeks of the semester to resolve the conflict. Make-up exams, if given, require instructor notification prior to the exam and supporting documentation.

Grades: Grades will be based on projects and exams using the following breakdown:

Projects:	30%
Hour Exams:	45%
Final Exam:	25%

90% at least an	A-
80% at least a	B-
70% at least a	C-
60% at least a	D-
< 60%	F

All regrade requests must be submitted in writing, with a thorough and clear explanation of the issue and justification for the amount of points to be credited, within one week after the return of the graded assignment. If requested, the entire assignment in addition to the specific points in question can be reviewed. The resulting grade may be higher, lower or no change.

Services: If you are registered with the Office of Disability Services (http://ods.ua.edu), please make an appointment with me as soon as possible to discuss any course accommodations that may be necessary. If you have a disability but have not contacted the Office of Disability Services, please call (205) 348-4285 (Voice) or (205) 348-3081 (TTY) or visit 1000 Houser Hall East to register for services. Students with disabilities must be registered with the Office of Disability Services before receiving accommodations.

University counseling services are available at http://sa.ua.edu/counseling.

The University of Alabama is committed to an ethical, inclusive community defined by respect and civility. The UAct website (www.ua.edu/uact) provides a list of

reporting channels that can be used to report incidences of illegal discrimination, harassment, sexual assault, sexual violence, retaliation, threat assessment or fraud.

Weather: The guiding principle at The University of Alabama is to promote the personal safety of students, faculty and staff during severe weather events. Please be familiar with UA's severe weather guidelines (http://uanews.ua.edu/weather/) and be prepared to quickly move to safety if severe weather occurs. In general, classes will remain in session until the National Weather Service issues tornado warnings for the Tuscaloosa metro area.

Academic Misconduct: All students in attendance at The University of Alabama are expected to be honorable and to observe standards of conduct appropriate to a community of scholars. The University of Alabama expects from its students a higher standard of conduct than the minimum required to avoid discipline.

Honor Pledge: "I promise or affirm that I will not at any time be involved with cheating, plagiarism, fabrication, or misrepresentation while enrolled as a student at The University of Alabama. I have read the Academic Honor Code, which explains disciplinary procedures that will result from the aforementioned. I understand that violation of this code will result in penalties as severe as indefinite suspension from the University."

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Schedule

Date		Topic	Reading Assignment
Aug	19	Course Policies and Road Map	1 – 8
	21	Fluid Properties, Standard Atmosphere	9 – 28
	24	Conservation Equation Review	33 – 42, 46
	26	Navier-Stokes Equations	42 – 46, 63 – 65
	28	Discussion and Examples	
	31	Differential Applications	46 – 52
Sep	2	Integral Applications	52 – 55
	4	Project 1 Description; Discussion and Examples	
	7	***Holiday: Labor Day***	
	9	Similarity Parameters	55 – 62
	11	Inviscid Flows and Bernoulli Equation	88 – 99
	14	Flow Kinematics and Circulation	99 – 102
	16	**Exam 1**	**Chps 1 and 2**
	18	Velocity Potential and Stream Function	103 – 112
	21	Elementary Potential Flows	113 – 126
	23	Non-lifting Cylinder Flow	126 – 139
	25	Discussion and Examples	
	28	Lifting Cylinder Flow	139 – 148
	30	Discussion and Examples	
Oct	2	Project 2 Description	
	5	Laminar Boundary Layers	63 – 65, 166 – 181
	7	Transition	189 – 202, 256 – 259
	9	Discussion and Examples	
	12	Turbulent Boundary Layers	204 – 215
	14	**Exam 2**	**Chps 3 and 4**
	16	Discussion and Examples	
	19	Aerodynamic Forces and Coefficients	226 – 231, 244 – 255, 263 – 273
	21	Airfoil and Wing Geometry	231 – 241
	23	Discussion and Examples	
	26	Thin Airfoil Theory	294 – 306
	28	Thin Airfoil Theory	306 – 316
	30	***Holiday: Fall Break***	
Nov	2	Discussion and Examples	
	4	Lift and Drag of Finite Wings	274 – 287
	6	Lifting Line Theory	341 – 357
	9	Discussion and Examples	
	11	**Exam 3**	**Chps 5 and 6**
	13	Project 3 Description	358 – 375
	16	Lifting Line Theory	358 – 375
	18	Low-*Re* and High-Alpha Effects	317 – 336, 408 – 414
	20	Discussion and Examples	
	24 – 28	***Thanksgiving Break***	
	30	Subsonic, Compressible Flow	432 – 445, 505 – 517
Dec	2	Transonic and Supercritical Airfoils	517 – 527
	4	Discussion and Examples	
	11	**Final Exam** (11:30)	**Cumulative**