DEPARTMENT: MECHANICAL ENGINEERING

COURSE #: EAS 4101 3 credits
Course Website

COURSE TITLE:
Fundamentals of Aerodynamics

TYPE COURSE:
Technical Elective
UG Track Certification area: Aeronautics Track

TERMS OFFERED: Spring

CATALOG DESCRIPTION:
This course is a technical elective course designed for senior-level engineering students in the Aeronautics Track and area of thermal and fluid sciences. The course includes fundamental fluid mechanics and aerodynamic principles in the design of airfoil and aircraft wings. It provides a comprehensive review concerning applications, technological advances, and social impacts on the development of a modern flight vehicle. The course provides an overview of the guiding principles and experimental observations to analyze basic aerodynamic characteristics of an aircraft configuration.

PREREQUISITES: EML 3015C, Thermal-Fluids I and EML 3016C, Thermal-Fluids II

AREA COORDINATOR: Dr. Rajan Kumar
RESPONSIBLE FACULTY: Dr. Rajan Kumar

INSTRUCTOR OF RECORD: Dr. Rajan Kumar
Building, Office room number AME 206
(850) 645-0149
rkumar@fsu.edu
Office Hours: (asynchronous and synchronous)

DATE OF PREPARATION: 07/18/2017 (RK)

CLASS SCHEDULE:

Class: Two times weekly for 1 hr. and 15 min.

Lab: No

TEXTBOOKS/REQUIRED MATERIAL:
1. Fundamentals of Aerodynamics, Anderson, J. D., Jr., 2011

References, Additional Resources:
- Aerodynamics for Engineers, Bertin, J. J. and Cummings, R. M., 2008
- Aerodynamics for Engineering Students, Houghton, E. L. and Carpenter, P. W., 2003
- Introduction to Flight, Anderson, J. D., Jr., 2011
- Flight Vehicle Aerodynamics, Drela, M., 2014

SCIENCE/DESIGN (%): 75% / 25%

CONTRIBUTION TO MEETING THE PROFESSIONAL COMPONENT:
75% engineering science
25% engineering design

COURSE TOPICS:
The topics to be covered includes (not necessarily in the order shown)

1. Physics of Aerodynamic Flows. Introduction and review of fundamental of aerodynamics, aerodynamic forces and moments, the aerodynamic coefficients and center of pressure.
2. Review of vector relations: relationship between line, surface and volume integrals.
3. Control Volume approach, continuity, momentum and energy equations and their application
4. Fundamentals of inviscid and incompressible flow, applied

ASSESSMENT TOOLS:
Undergraduate:
1. Weekly Homework problems (15%)
2. Group project report, published project web-source, and an oral presentation (formal lecture) (25%)
3. Two exams (30%)
4. Final (30%)

aerodynamics: flow over a circular cylinder 5. Incompressible flow over airfoils: airfoil nomenclature, Kutta condition, classical thin airfoil theory 6. Incompressible flow over wings: Biot-Savart law, Prandtl's lifting line theory, delta wing 7. Compressible Flow: a brief review of thermodynamic relations, flow through wind tunnels 8. Compressible flow over airfoils: linear theory, sound barrier, area rule, supersonic airfoil drag 9. Introduction to viscous flow: qualitative aspects, similarity parameters 10. Laminar and turbulent boundary layers, Blasius solution 11. Hypersonic flows 12. Aircraft stability and control	

Student Learning Objectives for FSU Curriculum File Syllabus	At the end of the course the student should be able to 1. recognize the relevancy of fundamental principles (fluid mechanics and aerodynamics) and their importance in the analysis of a flight vehicle 2. calculate the aerodynamic characteristics of an airfoil and an aircraft wing 3. recognize the differences between incompressible and compressible, inviscid and viscous flow features
Justification for addition or change	Course is needed in order that students learn the fundamentals of aerodynamics needed to understand and analyze the flowfield around a flight vehicle.

Level of computer usage:	None ☐ Elementary ☑ Intermediate ☐ Advanced ☐
Modes of Instruction:	Lecture ☑ Lab ☐ DIS ☐ Discussion ☐ Other ☐
Core Curriculum Course:	Yes ☐ No ☑
Availability to other Majors:	Yes ☑ No ☐

ME COURSE OBJECTIVES* [related to ABET Student Outcomes]	(Numbers shown in brackets refer to department **Student Outcomes**) http://www.eng.fsu.edu/me/about_us/accred-info.html 1. To understand the application of fundamental fluid mechanics and aerodynamic principles and their application in the design of airfoil and aircraft wings [1, 5]. 2. To provide a comprehensive review concerning applications, technological advances, and social impacts on the development of a modern flight vehicle [7, 8, 9]. 3. To provide an overview of the guiding principles and experimental observations [1, 5]. 4. To understand and analyze basic aerodynamic characteristics of an aircraft configuration [1, 5]. 5. To learn and apply various flow visualization and pressure measurement techniques to calculate flow over canonical aerodynamic configurations [3, 5] 6. Estimate aerodynamic forces and moments for preliminary design and analysis [3, 10]. Numbers refer to Departmental Student Outcomes, e.g. for course object 1, [1, 5] refers to student outcomes 1 and 5.
ME COURSE OUTCOMES* [related to ME Course Objective] **= FSU Student Learning Objectives**	*(Numbers shown in brackets are links to Course Objectives above) 1. Be able to recognize the relevancy of fundamental principles (fluid mechanics and aerodynamics) and their importance in the analysis of a flight vehicle [1] 2. Be able to calculate the aerodynamic characteristics of an airfoil and an aircraft wing [3] 3. Be able to recognize the differences between incompressible and compressible, inviscid and viscous flow features [3]

ASSESSMENT TOOL DETAILS

GRADING/ EVALUATION:

- Additional assignments: some homework assignments, appropriate to the first-year graduate student level are optional for undergraduate students.
- Project: Undergraduates will work on team projects.

Grades will be based on the following breakdown of graded work:

Undergraduate:	
1. Homework	15%
2. Project & Presentation	25%
3. Test(s)	30%
4. Final	30%

Letter grades will be assigned equivalent to the following:

Undergraduate Grading Scale	
Numerical Score	**Letter Grade**
90 - 100	A
80 - 89	B
70 - 79	C
60 - 69	D
0 - 59	F

Departmental policy is that a grade of C or better is required to pass this course.

College of Engineering Undergraduate Policy:

- It is the policy of the College not to assign "plus and minus (+/-)" grades for undergraduate engineering courses. http://www.eng.fsu.edu/current/undergraduate/guide.html, see Grading Policies.
- Students are required to be familiar with Academic Policies and Requirements as outlined in the COE Student Handbook http://www.eng.fsu.edu/current/undergraduate/guide.html page 11

ASSIGNMENTS/RESPONSIBILITIES:

Student Responsibilities

- Participation Attendance
- Homework
- Other Daily Responsibilities
- Projects, including information on group processes
- Tests/Exams

Assessment Tools:

1. In-class problems
2. Group project reports
3. Group presentation
4. Homework
5. Quizzes (Quizzes will not be announced ahead of time)
6. Section tests

Examinations:

The date of all exams will be announced at least one (1) week in advance.

Final Examination: on the COE exam date see http://www.eng.fsu.edu/current/exam_schedule.html

Instructional Method(s)

The primary instructional method is a traditional in-class lecture. There will also be extensive use of the Blackboard web delivery system for distribution of course assignments and other materials. Course materials available from the textbook publisher may also be used. The use of online instructional techniques will be introduced.

COURSE SCHEDULE

Week	Topics to be covered (not necessarily in the order shown)
1	Physics of Aerodynamic Flows.,
2	Introduction and review of fundamental of aerodynamics
3	Aerodynamic forces and moments, the aerodynamic coefficients and center of pressure.
4	Review of vector relations: relationship between line, surface and volume integrals.
5	Control Volume approach, continuity, momentum and energy equations and their application
6	Fundamentals of inviscid and incompressible flow
7	Applied aerodynamics: flow over a circular cylinder
8	Incompressible flow over airfoils: airfoil nomenclature, Kutta condition, classical thin airfoil theory
9	Incompressible flow over wings: Biot-Savart law, Prandtl's lifting line theory, delta wing
10	Compressible Flow: a brief review of thermodynamic relations, flow through wind tunnels
11	Compressible flow over airfoils: linear theory, sound barrier, area rule, supersonic airfoil drag
12	Introduction to viscous flow: qualitative aspects, similarity parameters
13	Laminar and turbulent boundary layers
14	Hypersonic flows
15	Aircraft Stability and control

COURSE POLICIES:

Attendance Policy:

First day attendance is mandatory for FSU students, and first week attendance is mandatory for FAMU students. Students not in class during the first day (FSU) or first week (FAMU) are to be dropped from the course.

Excused Absences: Excused absences include documented illness, deaths in the immediate family and other documented crises, call to active military duty or jury duty, religious holy days, and official University activities. These absences will be accommodated in a way that does not arbitrarily penalize students who have a valid excuse Consideration will also be given to students whose dependent children experience serious illness.

Please note that the College of Engineering has a restrictive interpretation of what is considered a valid excuse for an absence. See: http://www.eng.fsu.edu/current/undergraduate/guide.html p. 5. If an absence is to be excused, make sure you check beforehand. In case of excused absence, the instructor will work with you to help you make up for missed time and catch up.

Unexcused Absences: A student having more than four unexcused absences will be dropped from the course and assigned the grade F. No exceptions. Tests and exams missed because of unexcused absence receive the grade 0. No exceptions.

Other projects and activities missed completely receive the grade 0 for those projects or activities. No exceptions.

Other Regulations

Note that the penalties for copying work may result in a failing grade for the course. If you are uncertain, please check with the instructor who assigned the work. Working together is encouraged in this course, but blatant copying is not.

Departmental Policy:

A student may continue in the B.S. in ME degree program unless one or more of the following conditions arise;

a. A grade below C in the second attempt of the same engineering course http://www.eng.fsu.edu/me/resources/pdf/ME_Prerequisite_Policy.pdf
b. More than three (3) repeat attempts in engineering courses. http://www.eng.fsu.edu/me/resources/pdf/ME_Excessive_Repeat_Policy.pdf
c. Violation of academic honor code as defined in university bulletin or catalog
d. Use of grade forgiveness (currently available for FAMU students only) in more than two (2) courses.

Make-up Assignments

A make-up examination may be granted to students with a valid excused absence. However, you must notify me in advance if your absence involves a planned event or observance of a religious holy day. If an emergency prevents you from attending a scheduled examination, you must notify me at your earliest opportunity. You must obtain a valid excused absence for the emergency to be eligible for a make-up examination. Students with a valid excused absence will not be arbitrarily penalized for missing an assignment. Students without a valid excused absence are not entitled to a make-up examination. However, certain class assignments may be accepted late, with penalty, without a valid excused absence.

DEPARTMENTAL STUDENT OUTCOMES

The department's student outcomes can be found at http://www.eng.fsu.edu/about/accreditation/program_outcome.html?ID=215&agency=ABET

Program Outcomes/Student Learning Outcomes

Student learning outcomes for students majoring in engineering may be found at http://www.eng.fsu.edu/outcomes

Location of Academic Learning Compacts (ALC)

COE: http://www.eng.fsu.edu/about/accreditation/program_outcome.html?ID=217&agency=ALC
FAMU: http://www.famu.edu/index.cfm?Assessment&CurrentALCs#engineering
FSU: http://learningforlife.capd.fsu.edu/smalcs/learningCompact.cfm?smalcId=62534

ACADEMIC HONOR POLICY

Students are expected to uphold the University Student Code of Conduct and/or University Academic Honor Code

The Florida A&M University is committed to academic honesty and its core values which include scholarship, excellence, accountability, integrity, fairness, respect, and ethics. These core values are integrated into its academic honesty policy. Being unaware of the Academic Honesty Policy is not a defense to violations of academic honesty. Academic Honesty Policy violations shall be reported and appropriate actions taken by the Department Chair and Associate Dean for Student Affairs and curriculum. The complete Florida A&M Student Code of Conduct - Regulation 2.012 (8a) can be found on (p. 5) http://www.famu.edu/judicialAffairs/Regulation%202_012%20Student%20Code%20of%20Conduct.pdf and in the Student Handbook "The Fang" p. 61 http://www.famu.edu/Students/STUDENT%20HANDBOOK%20%28FANG%29%202012-2014.Updated%208.22.13.pdf p 61

The Florida State University Academic Honor Policy outlines the University's expectations for the integrity of

students' academic work, the procedures for resolving alleged violations of those expectations, and the rights and responsibilities of students and faculty members throughout the process. Students are responsible for reading the Academic Honor Policy and for living up to their pledge to ". . . be honest and truthful and . . . [to] strive for personal and institutional integrity at Florida State University." (Florida State University Academic Honor Policy, found at http://fda.fsu.edu/Academics/Academic-Honor-Policy.)

AMERICANS WITH DISABILITIES ACT

During the first week of class students with disabilities needing academic accommodation should:

1) register with and provide documentation to the FAMU **LDEC** or FSU **SDRC**; and
2) bring a letter to the instructor indicating the need for accommodation and what type.

Please note that instructors are not allowed to provide classroom accommodation to a student until appropriate verification from the Student Disability Resource Center has been provided.

For more information about services available to FAMU students with disabilities, contact **The Learning Development and Evaluation Center (LDEC)**

677 Ardelia Court Florida A&M University Tallahassee, FL 32310 Nathaniel Holmes, Director Donna Shell, Asst. Director	599-3180 (phone) 561-2512 (fax) 561-2783 (TDD) http://www.famu.edu/index.cfm?a=EOP&p=ADA

For more information about services available to FSU students with disabilities, contact the: **Student Disability Resource Center (SDRC)**

874 Traditions Way 108 Student Services Building Florida State University Tallahassee, FL 32306-4167	(850) 644-9566 (voice) (850) 644-8504 (TDD) sdrc@admin.fsu.edu http://www.disabilitycenter.fsu.edu/

This syllabus and other class materials are available in alternative format upon request.

UNIVERSITY'S NON-DISCRIMINATION POLICY STATEMENT

FAMU: http://www.famu.edu/index.cfm?EOP&NON-DISCRIMINATIONPOLICYSTATEMENT
FSU: http://www.hr.fsu.edu/PDF/Publications/diversity/EEO_Statement.pdf

SYLLABUS CHANGE POLICY:

Except for changes that substantially affect implementation of the evaluation (grading) statement, this syllabus is a guide for the course and is subject to change with advanced notice.