MECH 435 – Low Speed Aerodynamics (3 units)

2013 Fall Semester

Scheduled Course: Lecture/Discussion  
Meeting Times: T R 12:30 pm – 1:45 pm LANG 106  
(Fall 2013 Class No. 4840)

Prerequisites:  
CIVL 321 – Fluid Mechanics, MATH 260 – Differential Equations  
Working knowledge of MS Excel, MATLAB®, or another programming language will be helpful.

Instructor: Jim Tan-atichat
Office/Telephone: O’Connell Rm. 424 / Tel. 898-6142 (898-5346 to leave messages)  
E-mail: JTan-atichat@csuchico.edu

Office Hours:  
Tuesday 3:00 pm – 3:50 pm  
Wednesday 4:00 pm – 4:50 pm  
Thursday 3:00 pm – 3:50 pm  
(Tentative)  
(Please check office door card for the latest revision(s) to the times shown above.)

Course Objective: To provide students with a basic knowledge of concepts needed to understand and analyze fluid flows around elementary body shapes, thin airfoils, and wings of finite span.


Some Professional Reference Periodicals:

- AIAA Journal  
- Journal of Aircraft  
- Journal of Fluid Mechanics  
- Journal of Fluids Engineering

Grading Basis:

<table>
<thead>
<tr>
<th>Component(s)</th>
<th>Approx. Weight</th>
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<tbody>
<tr>
<td>Homework Exercises</td>
<td>5% ~ 10%</td>
</tr>
<tr>
<td>Midterm Examination</td>
<td>20% ~ 15%</td>
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<tr>
<td>Literature Review Reports &amp; Presentations</td>
<td>25%</td>
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<tr>
<td>Project(s)</td>
<td>30% ~ 20%</td>
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<tr>
<td>Final Examination/Project*</td>
<td>20% ~ 30%</td>
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*Unless specified otherwise, Final Exam is scheduled on Tuesday December 17, 2013 at 2:00 – 3:50 p.m. (Please check CSU, Chico’s web site for your other classes)
Tentative Topics to be covered:

➢ **Low-speed aerodynamics:** *How does it fit in (airplane) flight considerations?*

➢ **Background Review:**

- Review of fluid properties
- Fluid statics
- The Standard Atmosphere
- Fundamentals of fluid mechanics
  - conservation laws
  - constant-property flows
  - Mach and Reynolds numbers as similarity parameters
  - Boundary layer concept
  - Bernoulli equation

➢ **Aerodynamics:**

- Dynamics of an incompressible, inviscid flow field
  - Air speed determination (via Bernoulli equation)
  - Pressure coefficient
  - Circulation, Irrotational flow, stream function concepts
  - Elementary flows (uniform, source/sink, potential vortex, doublet, etc.)
  - Superposition of elementary flows
  - Lift/drag coefficients as flow-field parameters
  - Flow around a cylinder (with and without circulation)

- Incompressible, viscous boundary layers
  - Governing equations and boundary conditions
  - Incompressible laminar and turbulent boundary layers

- Characteristic parameters for airfoil and wing aerodynamics

- Two-dimensional incompressible flow around thin airfoils

- Incompressible flow about wings of finite span

- Aerodynamic design considerations
University Policies and Campus Resources:

**Academic integrity**
Students are expected to be familiar with the University’s Academic Integrity Policy. With computer-based assignments, it is often tempting and convenient to copy the work of others. This is plagiarism and is not tolerated. Your own commitment to learning, as evidenced by your enrollment at California State University, Chico, and the University’s Academic Integrity Policy requires you to be honest in all your academic course work. Faculty members are required to report all infractions to the Office of Student Judicial Affairs. The policy on academic integrity and other resources related to student conduct can be found at: [http://www.csuchico.edu/sjd/integrity.shtml](http://www.csuchico.edu/sjd/integrity.shtml).

**Campus Policy in Compliance with the American Disabilities Act**
If you need course adaptations or accommodations because of a disability, or if you need to make special arrangements in case the building must be evacuated, please make an appointment with me as soon as possible, or see me during office hours. Students with disabilities requesting accommodations must register with the DSS Office (Disability Support Services) to establish a record of their disability.

Special accommodations for exams require ample notice to the testing office and must be submitted to the instructor well in advance of the exam date.

**Disability Services**
If you need course adaptations or accommodations because of a disability or chronic illness, or if you need to make special arrangements in case the building must be evacuated, please make an appointment with me as soon as possible, or see me during office hours. Please also contact Disability Support Services (DSS) as they are the designated department responsible for approving and coordinating reasonable accommodations and services for students with disabilities. DSS will help you understand your rights and responsibilities under the Americans with Disabilities Act and provide you further assistance with requesting and arranging accommodations. The Disability Support Services website is [http://www.csuchico.edu/dss](http://www.csuchico.edu/dss).

Finite-span wing showing span-wise pressure distribution, inboard vortex sheet and tip vortices [Ref. Design-centered Introduction to Aerospace Engineering, http://soliton.ae.gatech.edu]