Course Syllabus

AE443 - COMPUTATIONAL AERODYNAMICS

Instructor: Dr. ISMAIL H. TUNCER
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DESCRIPTION

REQUIREMENTS
- AE305, AE341, and the consent of the instructor
- Fluency in Fortran programming
- Experience in data processing with graphical output using GNUPlot, VISIT, PARAVIEW, TECPlot, MATLAB type software and/or graphics libraries

TEXTBOOK
- Lecture notes will be used.

REFERENCE BOOKS
- Low-Speed Aerodynamics by Joseph Katz and Allen Plotkin
- Computational Fluid Mechanics and Heat Transfer by Dale A. Anderson, John C. Tannehill and Richard H. Pletcher
- Computational Methods for Fluid Flow by Roger Peyret and Thomas D. Taylor
- Modern Compressible Flow with Historical Perspective by John D. Anderson
- Numerical Computation of Internal and External Flows, Volume 1-2, by Charles Hirsch

GRADING POLICY
2 term projects: 30%, homework/classwork assignments: 10%, midterm exam: 25%, final exam: 35%
## TENTATIVE OUTLINE

<table>
<thead>
<tr>
<th>Class hours</th>
<th>1. INTRODUCTION</th>
<th>2. PANEL METHODS and DESIGN OPTIMIZATION</th>
<th>3. SOLUTION OF TRANSONIC SMALL DISTURBANCE EQUATION</th>
<th>4. SOLUTION OF FULL POTENTIAL FLOW EQUATION</th>
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<tbody>
<tr>
<td>6 hrs</td>
<td>Preliminary remarks</td>
<td>Potential - irrotational, inviscid flows</td>
<td>Full potential flow equation</td>
<td>Strong conservation form of Full Potential flow Equation (FPE)</td>
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<td>Simplification of Navier-Stokes equations for inviscid flows</td>
<td>Integral formulation of the incompressible potential flow equation</td>
<td>Derivation of Transonic Small Disturbance (TSD) equation</td>
<td>Finite Difference formulation of the FPE equation</td>
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<td>Numerical solution of the integral equation using panel methods</td>
<td>Characteristic lines</td>
<td>Rotated upwinding in supersonic regions</td>
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<td>Gradient based design optimization</td>
<td>Domain of dependence and influence</td>
<td>Body fitted grids and curvilinear coordinates</td>
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<td>Inverse airfoil design using a panel method</td>
<td>Derivation of the Finite Difference Equation (FDE) for the TSD equation</td>
<td>Numerical mapping of body fitted grids onto Cartesian grids</td>
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<td>Project: Design optimization of airfoil profiles using a panel method</td>
<td>Murman-Cole switching/Upwinding in supersonic flow regions</td>
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