Instructor: Dr. Periklis Papadopoulos

Office Location: ENG 272-D

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Office Hours: Tues & Thurs 4:30 pm – 6:00 pm

Class Days/Time: Thurs / 6:00 pm – 8:45 pm

Classroom: E164

Prerequisites: BSAE or instructor consent

Course Description

The class will cover advanced topics in computational fluid dynamics and provide the students the opportunity to use numerical techniques to solve the Euler and Navier-Stokes equations. The students will use, grid generation, CFD, and visualization software for exercises and projects. The students will use leading commercial CFD software, such as CFD-FASTRAN, for aerodynamic and aerothermodynamic applications, specifically designed to model real aerospace industry applications. Course will introduce the students to state-of-the-art multiple moving body problems and the simulation of complex aerospace problems including missile launch, maneuvering and staging, and aircraft flight dynamics and store separation. The students will compute cases with the Navier-Stokes flow solver to benchmark its finite rate chemistry and thermal non-equilibrium modules. Students will be guided through these challenging applications.

Course Goals

Introduce students to:

- Explicit and implicit time differencing methods
- Central, upwind and characteristic spatial differencing techniques
• Classical relaxation methods
• Multigrid methods
• Splitting/factoring methods
• FASTRAN benchmark cases and applications
• Practical examples and real life lessons
• Contemporary methods and codes (FASTRAN)

Course Learning Outcomes (CLO)
Upon completion of this course students will be able to:

1. Develop and use of numerical tools
2. Perform stability analysis of a code
3. Determine the accuracy of numerical methods
4. Design computational methods based in linear theory
5. Develop a basic understanding of algorithms and methods of practical value (e.g. methods for the Euler and Navier-Stokes equations).
6. Perform benchmark studies for code-to-code validations and against experimental data.
7. Apply state-of-the-art CFD codes (FASTRAN) for important aerospace applications.

Required Texts/Readings

Textbook
Fundamentals of Computational Fluid Dynamics by Lomax, Pulliam and Zingg, Published by Springer-Verlag

Other Readings
Instructor Notes

Midterm & Final Project

• You must average at least 70% on your midterm and final project to receive an A or a B in the course.

Grading Information

Workouts  100 points
Homework  200 points
Midterm Exam 300 points
Final Project 400 points

Total 1000 points
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

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Topics, Readings, Assignments, Deadlines</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8/25 &amp; 9/1</td>
<td>Introduction Background on Advanced CFD trends and tools</td>
</tr>
<tr>
<td>2</td>
<td>9/8</td>
<td>Computational Geometry</td>
</tr>
<tr>
<td>3</td>
<td>9/15</td>
<td>Grid Generation / Computational Geometry</td>
</tr>
<tr>
<td>4</td>
<td>9/22</td>
<td>Model Equations / Topological Constructs / Final Project Proposal Due</td>
</tr>
<tr>
<td>5</td>
<td>9/29</td>
<td>Advanced Mesh Generation Techniques / Discussion of Boundary Conditions</td>
</tr>
<tr>
<td>6</td>
<td>10/6</td>
<td>Linearization, General Solutions, Finite Difference Formulations</td>
</tr>
<tr>
<td>7</td>
<td>10/13</td>
<td>Generalization of Compact Difference Schemes</td>
</tr>
<tr>
<td>8</td>
<td>10/20</td>
<td>Generalized Schemes of any Order</td>
</tr>
<tr>
<td>9</td>
<td>10/27</td>
<td>Central Differencing Schemes / 1st Interim Project Report Due / 1st Progress Presentations</td>
</tr>
<tr>
<td>10</td>
<td>11/3</td>
<td>Upwind Schemes</td>
</tr>
<tr>
<td>11</td>
<td>11/10</td>
<td>Exact vs. Discreet Solutions</td>
</tr>
<tr>
<td>12</td>
<td>11/17</td>
<td>General Solution of Coupled Systems of Equations</td>
</tr>
<tr>
<td>13</td>
<td>11/24</td>
<td>Time Marching Methods / 2nd Interim Project Report Due / 2nd Progress Presentations</td>
</tr>
<tr>
<td>14</td>
<td>12/1</td>
<td>Inherent and Numerical Stability</td>
</tr>
<tr>
<td>15</td>
<td>12/8</td>
<td>Stiffness and Stability Analysis</td>
</tr>
<tr>
<td>16</td>
<td>12/15</td>
<td>Final project presentations</td>
</tr>
<tr>
<td>Final Exam</td>
<td>Thursday, December 22</td>
<td>ENGR 164 at 6:00 pm – 8:45 pm / Final Project Presentations / Final Project Report Due</td>
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