Course Instructor
Dr. I. B. Celik, MAE Department, ibcelik@mail.wvu.edu
307 ESB, 304 293-3209, Office Hours – Tuesday and Thursday 9:00-10:30

Assisting Post Docs. :
Dr. Jose Escobar, Jescobar@mix.wvu.edu
114 ERB, 304 293 9956, Office Hours: Monday and Wednesday 3:00-4:00 PM
Dr. Tao Yang, Tao.Yang@mail.wvu.edu
309 ESB, 304 293 3197, Office Hours: Thursday and Thursday 3:30-4:30

Pre-Requisites
MAE 316 (numerical methods) or equivalent; MAE 331 (fluid mechanics) or MAE 335 (incompressible aerodynamics), or equivalent; Experience with FORTRAN, Matlab, or C

Course Web Site
http://cfd.mae.wvu.edu/mae433/

Text Book (Not required)

Course Description

Grading
The final grade in the course will be assigned on the following basis:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
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<tbody>
<tr>
<td>Homework</td>
<td>20%</td>
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<tr>
<td>Projects</td>
<td>25%</td>
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<tr>
<td>Midterm Exam</td>
<td>25%</td>
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<tr>
<td>Final Exam</td>
<td>30%</td>
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The upper and lower bounds of letter grades may vary somewhat compared to the usual scales of 90-80-70-60… depending on the distribution of the class statistics.

Expected Learning Outcomes for CFD
Students completing this course will:
- have an understanding of the governing equations and boundary conditions of fluid dynamics
- understand basic discretization techniques, grid generation, and CFD techniques
- have a familiarity with some numerical solution techniques
- understand some of the strengths and weaknesses of current CFD practices
- have some experience with a commercial CFD code
- appreciate the process of verification and validation of CFD results
- gain an adequate background to take a more advanced graduate-level CFD course
Course Topics:

- Introduction to CFD
- Governing Equations of Fluid Dynamics
- Boundary value problems involving ODE’s
- PDE’s and Systems of Equations
- Discretization Techniques: Finite Differences, Finite Volume Technique, Errors & Uncertainty
- Grid Generation & Transformation (only structured grids will be considered)
- Solving Model Equations: Heat Equation, Wave Equation & Laplace Equation
- CFD Techniques & Solution Philosophy
  - Turbulent versus Laminar Flows
  - Boundary Conditions
  - Calculation Verification & Model Validation
- Introduction to Commercial CFD Package (use Fluent or other readily available codes)
- Inviscid Flow Simulation
- Viscous Flow & Boundary Layer Simulation
- Project Development
- Benchmark Problems: Pipe Flow, Thin-Shear/Boundary-Layer Flows, Lid Driven Cavity, and Backward Facing Step etc.
- Project Work

Additional References

6. Computational Fluid Dynamics: The Basics With Applications, J. D. Anderson

McGraw-Hill Series in Mechanical Engineering (any edition)