AEROSP-523 Computational Fluid Dynamics

3 Credits, Fall 2015, Mon/Wed 1:00-2:30pm, FXB 1024

Instructor:

Karthik Duraisamy, FXB 3053, kdur@umich.edu

Office hours: Tue 10-11:30am, Wed 10-11:30am

Other hours: By appointment.

GSI:

TBD , TBD@umich.edu

Office hours: TBD

Other hours: By appointment.

Course Text:

No Text book is required. Lecture notes will be provided to supplement in-class teaching. Additional reading material and homework will be posted on CTOOLS.

Reference Texts:

1. Fundamental Algorithms in Computational Fluid Dynamics, Thomas H. Pulliam, David W. Zingg, 2014.

2. Numerical computation of internal and external flows : fundamentals of computational fluid dynamics, Charles Hirsch, 2007.

Both of these texts are available on-line via our library web-site $http://mirlyn.lib.umich.edu$.

Course goal:

This course is intended to impart both a foundational as well as a working knowledge of CFD. Students will perform mathematical analysis of numerical methods and write programs to numerically compute solutions to partial differential equations. The final part of the course will provide an exposure to the bigger picture of CFD as an engineering tool and focus on the basics of good CFD practice.

Pre-requisites:

Calculus, differential equations, fluid dynamics and computer programming skills.

Course contents:

Introductory material:

Intro to CFD

Classification of PDE, model equations

Numerical Methods and Analysis:

Finite difference operators

Taylor and Fourier analysis

1D and 2D Boundary Value Problems

Simple iterative methods (Jacobi, Gauss Seidel, SOR)

Multigrid methods

Advanced iterative methods (Conjugate Gradient, GMRES, etc)

Von Neumann analysis for fully discrete systems

Time integration methods

Matrix stability analysis and modified PDEs

Non-linear Hyperbolic PDEs

Upwind schemes for conservation laws

Finite Volume schemes

CFD in practice:

Turbulent flows (RANS, LES and DNS)
Verification & Validation, Uncertainties etc.
Best practices & Case studies in CFD

Grading:

Homeworks : 50 %,
Mid Term : 25 %,
Final : 25 %