MATH 499 Dr. Edward J. Brash
Spring 2021 edward.brash@cnu.edu
Office: Luter 304 594-7451
Office Hours: Mon/Wed/Fri 11:00am-noon, or by appointment

Computational Fluid Dynamics

Learning Objectives:

- to become familiar with the differential equations for flow phenomena and with the numerical methods for their solution.

- to become competent in the use and development of flow simulation software (in Python) for the most important classes of flows in mathematics and physics.

- to develop critical analysis abilities for different mathematical models and computational methods for flow simulations.

- to undertake flow computations using current best practices for model and method selection, and assessment of the quality of results obtained.

Textbook: CFD Python: the 12 Steps to Navier-Stokes Equations
Lorena A. Barba and Gilbert F. Forsyth

Topics:

1. Linear convection in one dimension
2. Non-linear convection in one dimension
3. Diffusion
4. Burger's Equation with periodic boundary conditions
5. Linear convection in two dimensions
6. Non-linear convection in two dimensions
7. Laplace's Equation with Neumann and Dirichlet boundary conditions
8. Poisson Equation in two dimensions
9. Navier-Stokes equation in two dimensions
10. Applications: Cavity and Channel Flow

Meeting Times: We will meet twice weekly, during my office hours, to discuss progress, course material, homework assignments, and the final project in the course.

Homework: Programming assignments (in Python) will be given periodically, usually once every 10 days, and in most cases will be due approximately one week later.

Final Project: There will be a comprehensive final project in this course that will involve developing the advanced analysis code for another application of the Navier-Stokes equations beyond cavity and channel flow in two dimensions. I will discuss the details of the project with the student to find a suitable application to develop.

Grading:	Homework	60%
	Comprehensive Final Project	40%

The evaluation of your performance in this course will be based entirely on the regular homework assignments and the final project. There is no possibility to do extra work for extra credit.

Final grades will be assigned as follows:

A = 87-100%; A^- = 80-86 %
B^+ = 77-89 %; B = 73 –77 %; B^- = 70 – 73 %
C^+ = 67-79%; C = 63 –67 %; C^- = 60 – 63 %
D^+ = 57-69%; D = 53 –57 %; D^- = 50 – 53 %: F < 50%

Additional Information, provided by the CNU Administration, which you may find useful (and with which I happen to agree):

Disabilities:

In order for a student to receive an accommodation for a disability, that disability must be on record in the Office of Student Affairs, 3rd Floor, David Student Union (DSU). If you believe that you have a disability, please contact Dr. Kevin Hughes, Vice President of Student Affairs (594-7160) to discuss your needs. Dr. Hughes will provide you with the necessary documentation to give to your professors.

Students with documented disabilities are required to notify the instructor no later than the first day on which they require an accommodation (the first day of class is recommended), in private, if accommodation is needed. The instructor will provide students with disabilities with all reasonable accommodations, but students are not exempted from fulfilling the normal requirements of the course. Work completed before the student notifies the instructor of his/her disability may be counted toward the final grade at the sole discretion of the instructor.

Success:

I want you to succeed in this course and at Christopher Newport. I encourage you to come see me during office hours or to schedule an appointment to discuss course content or to answer questions you have. If I become concerned about your course performance, attendance, engagement, or well-being, I will speak with you first. I also may submit a referral through our Captains Care Program. The referral will be received by the Center for Academic Success as well as other departments when appropriate (Counseling Services, Office of Student Engagement). If you are an athlete, the Athletic Academic Support Coordinator will be notified. Someone will contact you to help determine what will help you succeed. Please remember that this is a means for me to support you and help foster your success at Christopher Newport.

Academic Support:

The Center for Academic Success offers free tutoring assistance for Christopher Newport students in several academic areas. Staff in the center offer individual assistance and/or workshops on various study strategies to help you perform your best in your courses. The center also houses the Alice F. Randall Writing Center. Writing consultants can help you at any stage of the writing process, from invention, to development of ideas, to polishing a final draft. The Center is not a proofreading service, but consultants can help you to recognize and find grammar and punctuation errors in your work as well as provide assistance with global tasks. Go as early in the writing process as you can, and go often!

You may visit the Center for Academic Success to request a tutor, meet with a writing consultant, pick up a schedule of workshops, or make an appointment to talk one-on-one with a University Fellow for Student Success. The Center is located in Christopher Newport Hall, first floor, room 123.