Syllabus for ME138-01: Intro to Comp Fluid Dynamics

Fall 2018
Instructor: Venkattraman Ayyaswamy

Designation:	Upper division undergraduate
Catalog Description:	This course will expose students to the theory behind computational techniques used in the study of fluid flows in natural and engineered systems. The course will also provide a hands-on introduction to the various steps involved in obtaining a numerical solution for fluid flow problems.
Text Books and Other Required Materials:	H. K. Versteeg and W. Malalasekara, ``An Introduction to Computational Fluid Dynamics: The Finite Volume Method", 2nd edition, 2007.
Course Objectives/ Student Learning Outcomes:	Upon successful completion of this course, students will be able to use typical computational fluid dynamics software to analyze various laminar and turbulent flows. They will also develop an understanding of the various numerical techniques involved thereby enabling them to assess the accuracy of the obtained solution.
Program Learning Outcomes:	
Prerequisites by Topic:	ENGR 120 (Fluid Mechanics)
Course Policies:	
Academic Dishonesty Statement:	a. Each student in this course is expected to abide by the University of California, Merced's Academic Honesty Policy. Any work submitted by a student in this course for academic credit will be the student's own work. b. You are encouraged to study together and to discuss information and concepts covered in lecture and the sections with other students. You can give "consulting" help to or receive "consulting" help from such students. However, this permissible cooperation should never involve one student having possession of a copy of all or part of work done by someone else, in the form of an e mail, an e mail attachment file, a diskette, or a hard copy. Should copying occur, both the student who copied work from another student and the student who gave material to be copied will both automatically receive a zero for the assignment. Penalty for violation of this Policy can also be extended to include failure of the course and University disciplinary action. c. During examinations, you must do your own work. Talking or discussion is not permitted during the examinations, nor may you compare papers, copy from others, or collaborate in any way. Any collaborative behavior during the examinations will result in failure of the exam, and may lead to failure of the course and University disciplinary action.
Disability Statement:	Accommodations for Students with Disabilities: The University of California Merced is committed to ensuring equal academic opportunities and inclusion for students with disabilities based on the principles of independent living, accessible universal design and diversity. I am available to discuss appropriate academic accommodations that may be required for student with disabilities. Requests for academic accommodations are to be made during the first three weeks of the

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	semester, except for unusual circumstances. Students are encouraged to register with Disability Services Center to verify their eligibility for appropriate accommodations.
Topics:	Introduction: What is Computational Fluid Dynamics (CFD); How does CFD work; Problem solving with CFD. Conservation Laws of Fluid Motion and Boundary Conditions: Review of mass, momentum and energy conservation equations; Equation of state; Navier-Stokes equations for a Newtonian fluid; Conservative form; Classification method for partial differential equations; Classification of fluid flow equations Finite Volume Method: Discretization scheme properties (conservativeness, boundedness and transportiveness); Discretization of diffusion problems in one, two and three dimensions; Convection-Diffusion problems discretization; Central differencing; Upwind differencing; Hybrid scheme; power law scheme; QUICK scheme Algorithms for pressure-velocity coupling in Steady Flows: Staggered grid; SIMPLE algorithm; SIMPLER and SIMPLEC algorithm; PISO algorithm Solution of Discretized Equations: Tri-diagonal matrix algorithm in one, two and three dimensions Finite Volume Method for Unsteady Flows: One-dimensional unsteady heat conduction; Explicit, Crank-Nicholson and Implicit schemes; Transient Convection-Diffusion equation; Transient SIMPLE; Transient PISO Boundary Conditions: Inlet; Outlet; Wall; Constant pressure; Periodic or cyclic Turbulence Models: Mixing length model; k-epsilon model; Reynolds stress equation models; Algebraic stress equation models
Class/laboratory Schedule:	TR 9:00-10:15 am (lecture); F 1:30 pm-4:20 pm (lab)
Midterm/Final Exam Schedule:	
Course Calendar:	
Professional Component:	
Assessment/Grading Policy:	Homeworks: 25% Labs: 20% Midterm 1 : 15% Midterm 2: 15% Final Exam: 25%
Coordinator:	
Contact Information:	
Office Hours:	Instructor: TR 10:30-11:30 am