ME 4342 Computational Fluid Dynamics (Elective)

Catalog Description: ME 4342 Computational Fluid Dynamics (2-3-3)

Prerequisites: ME 3345 Heat Transfer

The use of modern computational fluid dynamics software in mechanical engineering. Build, solve, and visualize fluid-flow models to gain a deeper understanding of the principles of fluid mechanics.

Textbook: No textbook.

Topics Covered:

1. Introduction to the use of modern CFD software, including geometry building, mesh generation, solution techniques, and flow visualization.
2. The investigation of various fluid flow systems aimed at a deeper understanding of the basic principles of fluid mechanics.
3. Experience with some of the difficulties that one may encounter in CFD, such as geometry simplification, mesh problems, convergence problems, multiple solutions, etc.
4. An individual CFD project selected from a set contributed by the instructor or from the student's own experience. A written project report is required.

Course Outcomes:

Outcome 1: Provide the student with a significant level of experience in the use of modern CFD software for the analysis of complex fluid-flow systems.

1.1 The student will demonstrate the ability to use modern CFD software tools to build flow geometries, generate an adequate mesh for an accurate solution, select appropriate solvers to obtain a flow solution, and visualize the resulting flow field.
1.2 The student will demonstrate the ability to analyze a flow field to determine various quantities of interest, such as flow rates, heat fluxes, pressure drops, losses, etc., using flow visualization and analysis tools.

Outcome 2: Improve the student's understanding of the basic principles of fluid mechanics.

2.1 The student will demonstrate an ability to recognize the type of fluid flow that is occurring in a particular physical system and to use the appropriate model equations to investigate the flow.
2.2 The student will demonstrate an ability to describe various flow features in terms of appropriate fluid mechanical principles and force balances.

Outcome 3: Improve the student's research and communication skills using a self-directed, detailed study of a complex fluid-flow problem and to communicate the results in written form.

3.1 The student will demonstrate the ability to simplify a real fluid-flow system into a simplified model problem, to select the proper governing equations for the physics involved in the system, to solve for the flow, to investigate the fluid-flow behavior, and to understand the results.
3.2 The student will demonstrate the ability to communicate the results of this detailed fluid-flow study in a written format.

Correlation between Course Outcomes and Student Outcomes:

ME 4342										
	Mechanical Engineering Student Outcomes									
Course Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Outcome 1.1	X				X				X		X
Course Outcome 1.2	X				X				X		X
Course Outcome 2.1	X				X						X
Course Outcome 2.2	X				X		X				X
Course Outcome 3.1	X				X				X		X
Course Outcome 3.2							X		X		

GWW School of Mechanical Engineering Student Outcomes:

(a) an ability to apply knowledge of mathematics, science and engineering

(b) an ability to design and conduct experiments, as well as to analyze and interpret data

(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

(d) an ability to function on multidisciplinary teams

(e) an ability to identify, formulate, and solve engineering problems

(f) an understanding of professional and ethical responsibility

(g) an ability to communicate effectively

(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

(i) a recognition of the need for, and an ability to engage in life-long learning

(j) a knowledge of contemporary issues

(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

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