Mechanical Engineering Dept. Department

Syllabus
ME 446: Comp. Fluid Dyna & Heat Trans (3-0-3)

Course Catalog Description:

Introduction to computational fluid dynamics as an engineering tool for the analysis and design of thermal-fluid systems. Fundamental equations of fluid mechanics in differential and integral form and common approximations. Discretization and solution methods for incompressible flow. Application of numerical techniques to the solution of some practical fluid flow and heat transfer problems. Turbulence models and their implementation in CFD. Application of commercial CFD codes to illustrative fluid flow and heat transfer problems.

Course Pre-requisites:

- ME 315: Heat Transfer

Course Objectives:

1. Introduce computational modeling tools in the area of fluid mechanics and heat transfer.
2. Enable the students with best numerical skills to solve fluid flow and heat transfer practical problems.
3. Train the students to use available Computational Fluid Dynamics (CFD) software to solve practical problems.

Course Learning Outcomes:

CLO1. Develop student’s skills to mathematical model an engineering problem and solve it by numerical methods

CLO2. Develop the understanding of application of conservation principles in fluid mechanics and heat transfer.

CLO3. Develop the basic understanding of the theory and principles used in computational fluid dynamics and heat transfer.

CLO4. Develop concepts of turbulence modeling for complex fluid flow and heat transfer problems.

CLO5. Develop the theoretical background for effective use of commercial CFD codes.

CLO6. Gain some experience in using commercial CFD software for the analysis and design of complex fluid flow and heat transfer systems.

CLO7. Develop the ability to analyze and interpret data obtained from the numerical solution of fluid flow and heat transfer problems.

Learning Resources:

- J. Tu, G. H. Yeoh, and C. Li, Computational Fluid Dynamics, A Practical Approach, 3rd ed., 2019, BH pub. Online: https://www.sciencedirect.com/book/9780081011270
- CFD software and manual available in ME computer labs.

Lecture Assessment Plan:

Assessment Task	Week Due	Weight
HWs and CFD exercices	1-15	20.0%
Project	15	30.0%
Final Exam	16	30.0%
Midterm	9	20.0%

Lecture Weekly Schedule:

Week#	Topics
1	Introduction to CFD and its applications.
	Review of the governing equations and common approximations
2	Review of the governing equations and common approximations (Continue)
3	The general scalar transport equation.
4	The general scalar transport equation. (Continue)
5	The finite volume method and discretization of the advection diffusion equation.
6	The finite volume method and discretization of the advection diffusion equation. (Continue)
7	The finite volume method and discretization of the advection diffusion equation. (Continue)
8	The finite volume method and discretization of the advection diffusion equation. (Continue)
9	Time –dependent calculations.
10	Special treatment of the Navier-Stokes equation and the pressure-corrections method.
11	Introduction to Turbulence Modeling
12	Commercial CFD codes and their application to practical problems
13	Commercial CFD codes and their application to practical problems (Continue)
14	Commercial CFD codes and their application to practical problems (Continue)
15	Commercial CFD codes and their application to practical problems (Continue)
	CFD Lab Practical