STATE UNIVERSITY OF NEW YORK !
COLLEGE OF TECHNOLOGY !
CANTON, NEW YORK !

MASTER SYLLABUS

COURSE NUMBER – COURSE NAME
MECH 416 – APPLIED COMPUTATIONAL FLUID DYNAMICS

Created by: Dr. Lucas Craig

Updated by:

Canino School of Engineering Technology !

Department: MET !

Semester/Year: Spring 2019 !

A. **TITLE**: Applied Computational Fluid Dynamics

B. **COURSE NUMBER:** MECH 416

C. **CREDIT HOURS: (Hours of Lecture, Laboratory, Recitation, Tutorial, Activity)**

 # Credit Hours: 3
 # Lecture Hours: 3 **per week**
 # Lab Hours: **per week**
Other: **per week**

Course Length: 15 **Weeks**

D. **WRITING INTENSIVE COURSE**: Yes ☐ No ☒

E. **GER CATEGORY: None:** ☒ **Yes:** GER !
***If course satisfies more than one*:** GER !

F. **SEMESTER(S) OFFERED: Fall** ☒ **Spring** ☒ **Fall & Spring** ☐

G. **COURSE DESCRIPTION:**

This course introduces the student to modeling and analyzing fluid mechanics problems via the finite difference and finite volume method. Fundamentals of CFD theory, solution, procedures, techniques, and analysis are discussed. Topics include computational grid generation, fluid model setup, convergence and accuracy analysis, data interpretation, model validation and discussion of conclusions. Students will use CFD software to solve various fluid problems.

H. **PRE-REQUISITES: None** ☒ **Yes** ☒ **If yes, list below:**

MECH 341 and MATH 364

CO-REQUISITES: None ☒ **Yes** ☐ **If yes, list below:**

I. STUDENT LEARNING OUTCOMES: (*see key below*)

By the end of this course, the student will be able to:

Course Student Learning Outcome [SLO]	***Program Student Learning Outcome [PSLO]***	***GER*** *[If Applicable]*	***ISLO & SUBSETS***	
Define fluid application domain and create geometric model.	1,2, 6		2-Crit Think ISLO ISLO	PS Subsets Subsets Subsets
Create computational mesh	1,2, 6		2-Crit Think ISLO ISLO	PS Subsets Subsets Subsets
Assess fluid properties and boundary conditions	1,2, 6		2-Crit Think ISLO ISLO	PS Subsets Subsets Subsets
Evaluate appropriate fluid model to simulate the fluid applications.	1, 2, 6		2-Crit Think ISLO ISLO	PS Subsets Subsets Subsets
Carry out the solution procedures and address convergence, stability, and accuracy analysis.	1,2,6		2-Crit Think ISLO ISLO	PS Subsets Subsets Subsets
Collect and analyze CFD data.	1,2,6		2-Crit Think ISLO ISLO	PS Subsets Subsets Subsets

Perform model validation.	1,2, 6		2-Crit Think ISLO ISLO	PS Subsets Subsets Subsets
			ISLO ISLO ISLO	Subsets Subsets Subsets Subsets
			ISLO ISLO ISLO	Subsets Subsets Subsets Subsets
			ISLO ISLO ISLO	Subsets Subsets Subsets Subsets

KEY	**Institutional Student Learning Outcomes [ISLO 1 – 5]**
ISLO #	**ISLO & Subsets**
1	**Communication Skills** Oral [O], Written [W]
2	**Critical Thinking** *Critical Analysis [CA] , Inquiry & Analysis [IA] , Problem Solving [PS]*
3	**Foundational Skills** *Information Management [IM], Quantitative Lit,/Reasoning [QTR]*
4	**Social Responsibility** *Ethical Reasoning [ER], Global Learning [GL], Intercultural Knowledge [IK], Teamwork [T]*
5	**Industry, Professional, Discipline Specific Knowledge and Skills**

*Include program objectives if applicable. Please consult with Program Coordinator !

J. APPLIED LEARNING COMPONENT: Yes ☒ No ☐

If YES, select one or more of the following categories:

- ☒ Classroom/Lab
- ☐ Internship
- ☐ Clinical Placement
- ☐ Practicum
- ☐ Service Learning
- ☐ Community Service
- ☐ Civic Engagement
- ☐ Creative Works/Senior Project
- ☐ Research
- ☐ Entrepreneurship (program, class, project)

K. TEXTS:

N/A

L. REFERENCES:

N/A

M. EQUIPMENT: None ☒ Needed:

N. GRADING METHOD: A-F

O. SUGGESTED MEASUREMENT CRITERIA/METHODS:

Homework	**25%**
Exams (3)	**60%**
Final Exam / Project	**15%**

P. DETAILED COURSE OUTLINE:

I. Introduction to Computational Fluid Dynamics
- **A. What is CFD**
- **B. Advantage of CFD**
- **C. Application of CFD**
- **D. Future of CFD**

II. CFD Solution Procedures
- **A. Introduction**
- **B. Problem Setup**
- **C. Computational Grid Generation**
- **D. Fluid Model Construction**
- **E. Fluid Properties and Boundary Conditions**
- **F. CFD Solver Processes**
- **G. Result Report and Visualization**

III. Governing Equations for CFD

A. Introduction

B. Continuity Equation

C. Momentum Equation

D. Energy Equation

E. Application Specific Equations

F. Generic Form of the Governing Equations for CFD

F. Physical Boundary Condition for Governing Equations

IV. CFD Techniques

A. Introduction

B. Discretization of Governing Equations

C. Finite-Difference Method

D. Finite-Volume Method

E. Converting Governing Equations to Algebraic Equations

F. Numerical Solution to Algebraic Equations

V. CFD Solution Analysis

A. Introduction

B. Consistency Analysis

B. Stability Analysis

C. Convergence Analysis

D. Accuracy Analysis

E. Computing Efficiency

Q. <u>LABORATORY OUTLINE</u>: None ☒ Yes ☐