Introduction to CFD ENGR 4390.001  
Department of Mechanical Engineering  
Fall 2017

A. COURSE INFORMATION

Course number/section: ENGR 4390.001  
Class meeting time: LEC: MWF 11:00-11:50 A.M.  
Class location: EN-214  
Course Website: Blackboard

B. INSTRUCTOR INFORMATION

Instructor: Zhaorui Li Ph.D.  
Office location: EN-316R  
Office hours: MWF 1:00 P.M -3:00 P.M  
Telephone: 361-825-4170  
E-mail: zhaorui.li@tamucc.edu  
Appointments: Correspond using ISLANDER email

C. COURSE DESCRIPTION

This technical elective course introduces advanced undergraduate students to computational fluid dynamics as a means of solving different types of differential equations that arise in thermal-fluid systems. Fundamental equations of fluid mechanics in differential form will be discretized by finite difference method. The accuracy, convergence and stability of the numerical schemes will be analyzed. Students will implement some numerical schemes in computer codes and solve a number of model problems that are relevant to fluid mechanics.

D. PREREQUISITES AND COREQUISITES

Prerequisites  
MEEN 3345 – Heat Transfer

E. REQUIRED TEXTBOOK(S), READINGS AND SUPPLIES


Optional Textbook(s) or Other References


F. STUDENT LEARNING OUTCOMES AND ASSESSMENT

Assessment is a process used by instructors to help improve learning. Assessment is essential for effective learning because it provides feedback to both students and instructors. A critical step in this process is making clear the course’s student learning outcomes that describe what students are expected to learn to be successful in the course. The student learning outcomes for this course are listed below. By collecting data and sharing it with students on how well they are accomplishing these learning outcomes students can more efficiently and effectively focus their learning efforts. This information can also help instructors identify challenging areas for students and adjust their teaching approach to facilitate learning.

By the end of this course, students should be able to:

1. Derive the governing equations of fluid mechanics in both integral and differential form by using appropriate conservation principles.
2. Recognize the type of fluid equations and choose appropriate boundary conditions.
3. Discretize the partial differential equations by using finite difference method.
5. Identity and select appropriate numerical schemes for calculating different types of thermal-fluid problems.
6. Develop the capability to write efficiently computer codes.
7. Solve those typical model problems which illustrate a variety of physical phenomena encountered in fluid mechanics.
8. Develop the ability to present CFD results and write technical reports.
9. Have the preliminary knowledge on turbulence modeling and simulation techniques.

G. INSTRUCTIONAL METHODS AND ACTIVITIES

Lectures, group discussions, home assignments, course projects. Students are expected to develop their own computer codes to calculate their projects.

H. MAJOR COURSE REQUIREMENTS AND GRADING

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>% ofFINAL GRADE</th>
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<tbody>
<tr>
<td>Homework</td>
<td>10</td>
</tr>
<tr>
<td>Midterm Exam</td>
<td>20</td>
</tr>
<tr>
<td>Projects (2 @ 25% each)</td>
<td>50</td>
</tr>
<tr>
<td>Final Exam</td>
<td>20</td>
</tr>
<tr>
<td>Extra credits</td>
<td>5</td>
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</tbody>
</table>
## I. COURSE CONTENT/SCHEDULE (TENTATIVE)

<table>
<thead>
<tr>
<th>WEEK</th>
<th>Days/Date</th>
<th>TOPIC(S)</th>
<th>ASSIGNMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8/28, 8/30 &amp; 9/1</td>
<td>Intro &amp; Governing Equations of Fluid Dynamics (Chap 1 &amp; 2)</td>
<td></td>
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<tr>
<td>2</td>
<td>9/6 &amp; 9/8</td>
<td>Governing Equations (Chap 2)</td>
<td>HW#1</td>
</tr>
<tr>
<td>3</td>
<td>9/11, 9/13 &amp; 9/15</td>
<td>Partial Differential Equation (Chap 3)</td>
<td>HW#2</td>
</tr>
<tr>
<td>4</td>
<td>9/18, 9/20 &amp; 9/22</td>
<td>Basics of Discretization (Chap 4)</td>
<td>HW#3</td>
</tr>
<tr>
<td>5</td>
<td>10/2, 10/4 &amp; 10/6</td>
<td>Basics of Discretization (Chap 4)</td>
<td>Project 1 &amp; HW#4</td>
</tr>
<tr>
<td>6</td>
<td>10/9, 10/11 &amp; 10/13</td>
<td>Review and Exam 1^ (10/13)</td>
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<tr>
<td>7</td>
<td>10/16, 10/18 &amp; 10/20</td>
<td>Methods for Wave Equation (Note)</td>
<td>HW#5</td>
</tr>
<tr>
<td>8</td>
<td>10/23, 10/25 &amp; 10/27</td>
<td>Methods for Heat equation (Note)</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>10/30, 11/1 &amp; 11/3</td>
<td>Methods for Laplace’s equation (Note)</td>
<td>HW#6</td>
</tr>
<tr>
<td>10</td>
<td>11/6, 11/8 &amp; 11/10</td>
<td>Methods for Burger’s Equation (Note)</td>
<td>Project 2</td>
</tr>
<tr>
<td>11</td>
<td>11/13, 11/15 &amp; 11/17</td>
<td>Pressure-corrections method (Chap 6)</td>
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<tr>
<td>12</td>
<td>11/20</td>
<td>Projects discussion</td>
<td></td>
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<tr>
<td>13</td>
<td>11/27, 11/29 &amp; 12/1</td>
<td>Intro to Turbulence Modeling (Note)</td>
<td>HW#7</td>
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<tr>
<td>14</td>
<td>12/4 &amp; 12/6</td>
<td>Review and discussion</td>
<td></td>
</tr>
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<td>15</td>
<td>Dec 8</td>
<td>Final Exam: 11:00 am-1:30 pm</td>
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*Target dates may be adjusted depending on material covered.

Note: Changes in this course schedule may be necessary and will be announced to the class by the Instructor. The assignments and exams shown are directly related to the Student Learning Outcomes described in Section F.

## J. COURSE POLICIES

### Attendance/Tardiness
Attendance is not mandatory but students are strongly to attend the classes and any absences should inform instructor in advance. Students with less than 3 absences may be granted up to 5 extra credits.

### Quizzes:
There are no in class quizzes.

### Exams:
- **Open book and notes.**
- Combination of concept questions and workout problems.
No smart devices, tablets, computers, etc. are allowed.

Final exam will cover selected chapters taught

**Assignments:** Homework is due on the announced day at the beginning of class. Multiple problems will be assigned and all of them will be graded. So, to avoid missing grade, students should complete all assigned problems. The neater and more coherent the work, the better grade may be expected.

**Late Work and Make-up Exams**

**Late Homework:** Late submission of homework will be subjected to lowering of Maximum points (1 day late, 15% off, 2-3 days late, 30% off, 4+ days late, 60% Off). Homework submission is not accepted after the graded work has been returned to the class.

**Make-up Exam:** will only be allowed with a valid (university approved) excuse. Exams need to be made up within one week from the missed time. Make-up exam may be different with what was given to other students.

**Extra Credit**

*Up to 5 points extra credit may be granted to some students who show excellent behavior in the classes,* which include answering instructor’s questions actively and having excellent attendance record.

**Cell Phone Use**

During the class, cell phone should be muted and can only be used for emergency purposes. If you have a potential need, set it to vibrate only and speak to phone outside the classroom. No recording of the lectures is allowed without express written consent of the instructor or expressed authorization by disability services.

**Laptop Use**

In general, use of laptop is prohibited during class unless have instructor’s approval.

**Food in Class**

No eating or drinking is permitted during class.

**Missed Exam**

Make-up exam will only be allowed with a valid (university approved) excuse.

**Participation**

Students are expected to play an active role in class by asking or answering questions.

**Emailing**

Must use your Islander Email. If emailing, must include course number and section in subject heading as well as purpose of email. Example: ENGR2316.001: Missed quiz 10.
Others
Blackboard will be used through the semester to provide access to notes, example problems, and notifications regarding quizzes, homework, exams, projects, and so forth.

K. COLLEGE AND UNIVERSITY POLICIES

- **Academic Integrity (University)**
  University students are expected to conduct themselves in accordance with the highest standards of academic honesty. Academic misconduct for which a student is subject to penalty includes all forms of cheating, such as illicit possession of examinations or examination materials, falsification, forgery, complicity or plagiarism. (Plagiarism is the presentation of the work of another as one’s own work.) In this class, academic misconduct or complicity in an act of academic misconduct on an assignment or test will result in a failing grade.

- **Classroom/Professional Behavior**
  Texas A&M University-Corpus Christi, as an academic community, requires that each individual respect the needs of others to study and learn in a peaceful atmosphere. Under Article III of the Student Code of Conduct, classroom behavior that interferes with either (a) the instructor’s ability to conduct the class or (b) the ability of other students to profit from the instructional program may be considered a breach of the peace and is subject to disciplinary sanction outlined in article VII of the Student Code of Conduct. Students engaging in unacceptable behavior may be instructed to leave the classroom. This prohibition applies to all instructional forums, including classrooms, electronic classrooms, labs, discussion groups, field trips, etc.

- **Statement of Civility**
  Texas A&M University-Corpus Christi has a diverse student population that represents the population of the state. Our goal is to provide you with a high quality educational experience that is free from repression. You are responsible for following the rules of the University, city, state and federal government. We expect that you will behave in a manner that is dignified, respectful and courteous to all people, regardless of sex, ethnic/racial origin, religious background, sexual orientation or disability. Behaviors that infringe on the rights of another individual will not be tolerated.

- **Deadline for Dropping a Course with a Grade of W (University)**
  I hope that you never find it necessary to drop this or any other class. However, events can sometimes occur that make dropping a course necessary or wise. Please consult with your academic advisor, the Financial Aid Office, and me, before you decide to drop this course. Should dropping the course be the best course of action, you must initiate the process to drop the course by going to the Student Services Center and filling out a course drop form. Just stopping attendance and participation
WILL NOT automatically result in your being dropped from the class. Please consult the Academic Calendar (http://www.tamucc.edu/academics/calendar/) for the last day to drop a course.

- **Grade Appeals (College of Science and Engineering)**
  As stated in University Procedure 13.02.99.C2.01, Student Grade Appeal Procedures, a student who believes that he or she has not been held to appropriate academic standards as outlined in the class syllabus, equitable evaluation procedures, or appropriate grading, may appeal the final grade given in the course. The burden of proof is upon the student to demonstrate the appropriateness of the appeal. A student with a complaint about a grade is encouraged to first discuss the matter with the instructor. For complete details, including the responsibilities of the parties involved in the process and the number of days allowed for completing the steps in the process, see University Procedure 13.02.99.C2.01, Student Grade Appeal Procedures. These documents are accessible through the University Rules website at http://www.tamucc.edu/provost/university_rules/index.html, and the College of Science and Engineering Grade Appeals webpage at http://sci.tamucc.edu/students/GradeAppeal.html. For assistance and/or guidance in the grade appeal process, students may contact the chair or director of the appropriate department or school, the Office of the College of Science and Engineering Dean, or the Office of the Provost.

- **Disability Services**
  The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please call (361) 825-5816 or visit Disability Services in Corpus Christi Hall 116.

  If you are a returning veteran and are experiencing cognitive and/or physical access issues in the classroom or on campus, please contact the Disability Services office for assistance at (361) 825-5816.

  http://disabilityservices.tamucc.edu/

- **Statement of Academic Continuity**
  In the event of an unforeseen adverse event, such as a major hurricane and classes could not be held on the campus of Texas A&M University–Corpus Christi; this course would continue through the use of Blackboard and/or email. In addition, the syllabus and class activities may be modified to allow continuation of the course. Ideally, University facilities (i.e., emails, web sites, and Blackboard) will be operational within two days of the closing of the physical campus. However, students need to make certain that the course instructor has a primary and a secondary means of contacting each student.
L. OTHER INFORMATION

- Academic Advising
  The College of Science & Engineering requires that students meet with an Academic Advisor as soon as they are ready to declare a major. The Academic Advisor will set up a degree plan, which must be signed by the student, a faculty mentor, and the department chair. Meetings are by appointment only; advisors do not take walk-ins. Please call or stop by the Advising Center to check availability and schedule an appointment. The College’s Academic Advising Center is located in Center for Instruction 350 or can be reached at (361) 825-3928.

GENERAL DISCLAIMER

I reserve the right to modify the information, schedule, assignments, deadlines, and course policies in this syllabus if and when necessary. I will announce such changes in a timely manner during regularly scheduled lecture periods.