ENGG*4440 Computational Fluid Dynamics
Winter 2016

School of Engineering

(Revision 1: January 17, 2016)

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1 INSTRUCTIONAL SUPPORT

1.1 Instructor

Instructor: Syeda Tasnim, Ph.D., EIT

Office: THRN 2413, ext. 54013

Email: stasnim@uoguelph.ca

Office hours: By appointment

1.2 Lab Technician

Technician: N.A.

1.3 Teaching Assistant

GTA	Email	Office Hours
Olufemi Bamidele	obamidel@uoguelph.ca	TBA on CourseLink

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2 LEARNING RESOURCES

2.1 Course Website

News, announcements, and grades will be regularly posted to the ENGG*4440 CourseLink site. You are responsible for checking the site regularly.

2.2 Required Resources

1. H.K. Versteeg and W. Malalasekera, *An Introduction to Computational Fluid Dynamics*, 2nd Edition Pearson, 2007.

2.3 Recommended Resources

1. An undergraduate Fluid Mechanics textbook such as F. M. White, *Fluid Mechanics*, 7th Edition McGraw Hill, 2011.

2.4 Additional Resources

Lecture Information: Some of the lecture notes will be posted on the web page.

Lab Information: All of the necessary information for the lab sessions will be posted on the web page. Make sure you check the course website for relevant information before each session.

Assignments: There will be 5 assignment and 1 final project posted through out the term. Select solutions and assignment feedback will be posted regularly.

Miscellaneous Information: Other information related to Computational Fluid Dynamics will also be posted on the web page.

2.5 Communication & Email Policy

Please use lectures and lab sessions as your main opportunity to ask questions about the course. Major announcements will be posted to the course website. **It is your responsibility to check the course website regularly.** As per university regulations, all students are required to check their <mail.uoguelph.ca> e-mail account regularly: e-mail is the official route of communication between the University and its students.

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3 ASSESSMENT

3.1 Dates and Distribution

Assignments: 40% - to be submitted electronically through CourseLink Dropbox AND as a hard copy.
Assignment 1 – January 26 (5%)
Assignment 2 – February 9 (5%)
Assignment 3 – February 18 (10%)
Assignment 4 – March 2 (10%)
Assignment 5 – March 16 (10%)

Final Project: 35% - Due April 8 – to be submitted electronically AND as a hard copy.

Final Exam: 25% - April 22, 2:30 pm – 4:30 pm. Room to be announced. (Closed book exam)

3.2 Course Grading Policies

Missed Assessments: If you are unable to meet an in-course requirement due to medical, psychological, or compassionate reasons, please email the course instructor. See the undergraduate calendar for information on regulations and procedures for Academic Consideration: http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml

Accommodation of Religious Obligations: If you are unable to meet an in-course requirement due to religious obligations, please email the course instructor within two weeks of the start of the semester to make alternate arrangements. See the undergraduate calendar for information on regulations and procedures for Academic Accommodation of Religious Obligations: http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-accomrelig.shtml

Passing grade: In order to pass the course, you must obtain a grade of 50% or higher.

Lab Work: You must attend all laboratories. If you miss a laboratory due to grounds for granting academic consideration or religious accommodation, alternative arrangements must be made.

Late Assignments: Late submissions of assignments or project will not be accepted.

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4 AIMS, OBJECTIVES & GRADUATE ATTRIBUTES

4.1 Calendar Description

Computational methods for fluid mechanics form the core of the course. The concepts of modelling are covered including numerical analysis, the governing equations for fluid problems and finite discretization methods. Mathematical models for turbulence are presented and the student is exposed to the use of commercial software for the solution of complex problems in fluid dynamics.

Prerequisite(s): ENGG*2230, ENGG*3370

4.2 Course Aims

The goal of this course is to introduce the field of computational solutions to complex fluid flows. Students will be exposed to the nature of complex fluid flows, various numerical methods for solving the non-linear governing equations, and techniques for using commercially available CFD software. There is a focus on building and solving physical models in practical fluid dynamic applications.

4.3 Learning Objectives

At the successful completion of this course, the student will have demonstrated the ability to:

1. Comprehend, appreciate, and apply the physics of complex fluid flow
2. Build computational models to analyze complex fluid flows
3. Articulate the major approximations in CFD analysis and control the associated errors, recognizing the limits of the tool and assessing the validity of the conclusion.

4. Interpret and communicate computational results in coherent and understandable ways with both graphs and words

4.4 Graduate Attributes

Successfully completing this course will contribute to the following CEAB Graduate Attributes:

Graduate Attribute	Learning Objectives	Assessment
1. Knowledge Base for Engineering	1, 2	Assignments, Project, Exam, Presentation
2. Problem Analysis	1, 2	Assignments, Project, Exam
3. Investigation	4	Assignments, Project, Exam, Presentation
4. Design	2	Assignments, Project
5. Use of Engineering Tools	1, 2, 3, 4	Assignments, Project, Exam
6. Communication	-	Presentation
7. Individual and Teamwork	-	-
8. Professionalism	-	-
9. Impact of Engineering on Society and the Environment	-	-
10. Ethics and Equity	-	-
11. Environment, Society, Business, & Project Management	-	-
12. Life-Long Learning	-	-

4.5 Instructor's Role and Responsibility to Students

The instructor's role is to develop and deliver course material in ways that facilitate learning for a variety of students. Selected lecture notes will be made available to students on Courselink/D2L but these are not intended to be stand-alone course notes. During lectures, the instructor will expand and explain the content of notes and provide example problems that supplement posted notes.

4.6 Students' Learning Responsibilities

Students are expected to take advantage of the learning opportunities provided during lectures and labs and student participation is highly encouraged. Students, especially those having difficulty with the course content, should also make use of other resources recommended by the instructor. Students who do (or may) fall behind due to illness, work, or extra-curricular activities are advised to keep the instructor informed. This will allow the instructor to recommend extra resources in a timely manner and/or provide consideration if appropriate.

The dynamics of each learning activity should be based on professionalism and mutual respect. Cell phones are to be turned off during the class, ear buds must be put away, and the use of laptops and tablets in class is restricted to taking class notes.

Everyone in the classroom has the right to participate and contribute. If there is anything that may prevent your full contribution, let the instructor know as soon as possible. The learning environment must be free from harassment.

4.7 Relationships with other Courses & Labs

Previous Courses:

ENGG*2230: An introduction to many aspects of fluid properties, fluid motion, and engineering applications that involve fluid mechanics.

ENGG*3370: Relevant application of fluid mechanics.

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5 TEACHING AND LEARNING ACTIVITIES

5.1 Timetable

Lectures:

Tuesday & Thursday	8:30 – 9:50 am	MACK 235

Laboratory:

Friday	2:30 - 4:20 pm	THRN 2313

5.2 Lecture Schedule

Week	Lecture Topics	References
1	Why CFD?	Chapter 1
2	The Operational Steps of CFD	Chapter 1
3-4	Fluids and the Fundamental Equations	Chapter 2-3
4	The Finite Volume Method (Diffusion)	Chapter 4
5	The Finite Volume Method (Convection)	Chapter 5
6	Iterative Convergence	Chapter 6-7
7	Boundary Conditions and Grids	Chapter 9
8	Turbulence Modelling	Chapter 3
9	Errors and Uncertainty	Chapter 10
10	Project Introduction	-
11	Applications	-
12	Concluding Words	-

5.3 Seminar Schedule

NA

5.4 Lab Schedule

Week	Topic	Assessment
1	Introduction to Commercial CFD	Assignment #1
2	Developing Duct Flow	Assignment #2
3	Flow over Backward Step	Assignment #3
4	Post Processing	Assignment #3
5	Finite Volume Method	Assignment #4
6	Mesh Refinement	Assignment #4
7	Iterations and Time Steps	Assignment #5
8	Convergence	Assignment #5
9	Turbulence Modelling	Final Project
10-12	Work on Project	Final Project

5.5 Other Important Dates

Monday, January 11, 2016: First day of class
Monday, February 15 – Friday, February 20, 2016: Winter Break
Friday, March 11, 2016: drop date – 40th class
Friday, April 8 2016: last day of class

6 LAB SAFETY

Safety is critically important to the School and is the responsibility of all members of the School: faculty, staff and students. As a student in a lab course you are responsible for taking all reasonable safety precautions and following the lab safety rules specific to the lab you are working in. In addition, you are responsible for reporting all safety issues to the laboratory supervisor, GTA or faculty responsible.

If the laboratory rules are not followed, consequences will include removing student's access to the lab. If this results in lab work not being completed, the student will receive a grade of 0.

7 ACADEMIC MISCONDUCT

The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community faculty, staff, and students to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff and students have the

responsibility of supporting an environment that discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member.

7.1 Resources

The Academic Misconduct Policy is detailed in the Undergraduate Calendar:
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml

A tutorial on Academic Misconduct produced by the Learning Commons can be found at:
http://www.academicintegrity.uoguelph.ca/

Please also review the section on Academic Misconduct in your Engineering Program Guide.

The School of Engineering has adopted a Code of Ethics that can be found at:
http://www.uoguelph.ca/engineering/undergrad-counselling-ethics

8 ACCESSIBILITY

The University of Guelph is committed to creating a barrier-free environment. Providing services for students is a shared responsibility among students, faculty and administrators. This relationship is based on respect of individual rights, the dignity of the individual and the University community's shared commitment to an open and supportive learning environment. Students requiring service or accommodation, whether due to an identified, ongoing disability for a short-term disability should contact the Centre for Students with Disabilities as soon as possible

For more information, contact CSD at 519-824-4120 ext. 56208 or email csd@uoguelph.ca or see the website: http://www.uoguelph.ca/csd/

9 RECORDING OF MATERIALS

Presentations which are made in relation to course work—including lectures—cannot be recorded or copied without the permission of the presenter, whether the instructor, classmate or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

10 RESOURCES

The Academic Calendars are the source of information about the University of Guelph's procedures, policies and regulations which apply to undergraduate, graduate and diploma programs: http://www.uoguelph.ca/registrar/calendars/index.cfm?index