ENGG*4440: Computational Fluid Dynamics
Winter 2018

UNIVERSITY of GUELPH

School of Engineering

(Revision 1: January 5, 2018)

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1. INSTRUCTIONAL SUPPORT

1.1 Instructor

Instructor: Mostafa Elsharqawy, PhD, PEng
Office: THRN 2407
Email: melsharq@uoguelph.ca
Office Hours: Tuesday and Thursday 4 – 5 PM

1.2 Teaching Assistant

GTA	Email	Office Hours
Amir Nazem	anazem@uoguelph.ca	11 - 12 Friday in Room THRN 2129

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2. LEARNING RESOURCES

2.1 Course website

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

2.2 Required Resources

- H.K. Versteeg and W. Malalasekera, An Introduction to Computational Fluid Dynamics, 2nd Ed. Pearson, 2007.

2.3 Recommended Resources

- Suhas Patankar, Numerical Heat Transfer and Fluid Flow, CRC Press, 1980.
- John Wendt, and John Anderson, Computational Fluid Dynamics: An Introduction. Springer, 2009.
- M.B. Abbott, and D.R. Basco, Computational Fluid Dynamics: An Introduction for Engineers, John Wiley & Sons, Inc., New York, 1990.

2.4 Additional Resources

Lecture Information: Some lecture notes will be posted on the course website on CourseLink throughout the semester. You will be granted access to the website when you register for the course.

Lab Information: All 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: Download the assignments according to the schedule given in the CourseLink website.

Miscellaneous Information: Lectures are the main source of material which includes important discussions and worked examples that might not be found elsewhere. Other information related to this course will be posted on CourseLink.

2.5 Communication and Email Policy

Please use lectures and tutorials as your main opportunity to ask questions about the course. Major announcements and/or changes will be posted to the course website. It is your responsibility to check the course website regularly. Electronic communication should be limited to the course forum, however topics of a personal and confidential nature (e.g. marks) should be emailed to the instructor: melsharq@uoguelph.ca. Please note that all email communication must be made through your University of Guelph email account.

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3. ASSESSMENT

3.1 Dates and Distribution

Assignments: 30% (to be submitted electronically through CourseLink Dropbox)

Assignment #	Due date	Weight
1	Week #3 (26 Jan 2018)	6%
2	Week #5 (9 Feb 2018)	6%
3	Week #7 (2 Mar 2018)	6%
4	Week #9 (16 Mar 2018)	6%
5	Week #11 (30 Mar 2018)	6%

Mid-term Exam: In-class and in-lab tests for 30% (in-lab test of 9% is in Week #8 and in-class test of 21% is on 6 Mar 2018)

Project: 40%

Deliverable	Due date	Weight
Abstract submission to CFD conference	Week #6 (15 Feb 2018)	5%
Project presentation	Week #12 (6 Apr 2018)	5%
Final report	Week #12 (6 Apr 2018)	30%

3.2 Course Grading Policies

Academic Consideration: 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 Consideration of Religious Obligations:
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-accomrelig.shtml

Passing Grade: The exam and assignment portion (5 assignments + Mid-term Exams) accounts for 60% of the total mark of the course. The project portion accounts for 40% of the total mark of the course. In order to pass the course, you must meet the following two criteria:

- Score 30% or higher out of the 60% allocated to the exam and assignment portions of the course.
- Score 20% or higher out of the 40% allocated to the project portion of the course.

Failure to meet any of the two criteria will result in a failure grade (your total mark or 49%, whichever is less).

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.

Questions Concerning Grades: If you have questions about the grade of your assignment or test received, please ask your TA within one week of the document being returned. However, all requests for re-marking must be made to the instructor and accompanied by a re-marking request letter. Any item that is re-marked will be re-marked entirely. Therefore, it is strongly suggested that you thoroughly review your entire document before making a re-marking request. Pencil-written works will not be re-marked. Re-marking requests will not be honoured more than one week after the document has been returned.

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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

1.1 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
2. Problem Analysis	1, 2	Assignments, Project, Exam
3. Investigation	3, 4	Project
4. Design	-	-
5. Use of Engineering Tools	2, 3, 4	Project
6. Communication	4	Project
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	-	-

1.2 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 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. Scheduled classes will be the principal venue to provide information and feedback for assessments.

1.3 Students' Learning Responsibilities

Students are expected to take advantage of the learning opportunities provided during lectures and tutorials. 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.

1.4 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.

2. TEACHING AND LEARNING ACTIVITIES

2.1 Timetable

Lectures:

Day	Time	Location
Tuesday, Thursday	2:30PM - 3:50PM	MCKN 233

Labs:

Section #	Day	Time	Location
0101	Friday	2:30PM – 4:20PM	THRN 1004
0102	Wednesday	2:30PM – 4:20PM	THRN 1004

2.2 Lecture Schedule

Week	Lecture Topic
1	Course Introduction + Why CFD
2	The Operational Steps of CFD
3	Fluids and the Fundamental Equations
4	The Finite Volume Method (Diffusion)
5	The Finite Volume Method (Convection)
6	Iterative Convergence
7	Boundary Conditions and Grids
8	Tests
9	Errors and Uncertainty
10	Turbulence Modelling
11	Applications
12	Project presentations

2.3 Lab Schedule

Week	Lab Activity
1	MATLAB Introduction
2	MATLAB Problems
3	ANSYS Fluent Introduction
4	Developing Flow in Duct
5	Post Processing
6	Mesh Refinement
7	Iterations and Time Steps
8	Tests
9	Convergence
10	Turbulence Modelling
11	No Labs
12	Project Presentations

2.4 Disclaimer

The instructor reserves the right to change any or all of the above in the event of appropriate circumstances, subject to the University of Guelph Academic Regulations.

2.5 Important Dates

Monday, January 8, 2018: First day of classes
Feb 19 - 23, 2018: Reading Week (no classes)
Friday, March 9, 2018: 40th class day, last day to drop classes

3. 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.

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4. 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.

4.1 Resources

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

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5. 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/

6. 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.

7. 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/undergraduate/current/c08/c08-amisconduct.shtml