ME4J03
Introduction to Computational Fluid Dynamics and Heat Transfer

Undergraduate Studies
Winter 2025/26
Course Outline

CALENDAR/COURSE DESCRIPTION

This course is an introductory course in Computational Methods for Fluid Mechanics and Heat Transfer covering: concepts of modeling and numerical analysis, governing equations of thermo-fluid problems, finite-difference and finite-volume discretization methods, and introduction of the use of ANSYS-CFX CFD software package in solving Thermal Engineering problems.

PRE-REQUISITES AND ANTI-REQUISITES

Prerequisite(s): MECH ENG 3F04

Antirequisite(s): none

INSTRUCTOR OFFICE HOURS AND CONTACT INFORMATION

Dr. M. Hamed
JHE 203
hamedm@mcmaster.ca
ext. 26113

Office Hours:

by appointment

TEACHING ASSISTANT OFFICE HOURS AND CONTACT INFORMATION

Abdelfatah Teamah
JHE 215
teamaa1@mcmaster.ca

Office Hours:
TBA on A2L

COURSE WEBSITE/ALTERNATE METHODS OF COMMUNICATION

http://avenue.mcmaster.ca/

COURSE INTENDED LEARNING OUTCOMES

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

- Use one of the most advanced and powerful computational tools (ANSYS CFX) to solve and analyze fluid dynamics and heat transfer problems.
- Make physically justified assumptions to simplify and carry out feasible analysis of real-life fluid flow and heat transfer problems.

- Utilize scaling analysis to evaluate the order of magnitude of physical mechanisms in a problem, simplify governing equations and identify important scales (e.g., length, velocity, and time) and dimensionless quantities.

MATERIALS AND FEES

Required Texts:

1. "Computational Fluid Dynamics - A Practical Approach, J. Tu, G.H. Yeoh, and C.Liu, Elsevier Inc.
2. "Computational Fluid Dynamics for Engineers, T. Cebeci, J.P. Shao, F.Kafyeke, E. Laurendeau, Horizons Publishing.
3. "Introduction to Heat Transfer", Frank P. Incropera and David P. DeWitt, Wiley.

Calculator:
Only the McMaster Standard Calculator will be permitted in tests and examinations. This is available at the Campus Store.

Other Materials:
A number of illustrative videos will be made available on A2L.

COURSE FORMAT AND EXPECTATIONS

The course is organized as follows:

- 3 classroom-based lectures per week
- 1 classroom-based tutorial per week
- 1 closed-book, in-class, midterm test
- A closed-book, in-class, final exam. The final exam covers all course material.

All exams (i.e., midterm test and final) will include questions on theory and concepts covered in lectures and class discussions.

COURSE SCHEDULE

Date/Week	Topic	Readings
Jan 5	Part 1 - Introduction and CFD Solution Procedure	Class Notes
Jan 12	Introduction and CFD Solution Procedure - continued	Class Notes
Jan 19	Part 2 – Governing Equations for CFD	Class Notes
Jan 26	Governing Equations for CFD – continued and Part 3 - Practical Guidelines for CFD Simulation Analysis	Class Notes
Feb 2	Practical Guidelines for CFD Simulation Analysis – continued	Class Notes
Feb 9	Practical Guidelines for CFD Simulation Analysis – continued	Class Notes
Feb 16	Reading Week	
Feb 23	Midterm Test	Class Notes
Mar 2	Part 4 – Scaling Analysis	Class Notes
Mar 9	Part 5- CFD Techniques	Class Notes
Mar 16	CFD Techniques - continued	Class Notes
Mar 23	CFD Techniques - continued	Class Notes
Mar 30	Part 6 – Essentials of CFD Solution Analysis	Class Notes
Apr 6	Essentials of CFD Solution Analysis - continued	Class Notes

ASSESSMENT

Component	Due Date	Weight
Assignments	Roughly Weekly	15%
Twp Projects	Feb 2 and March 9	30%
Midterm Test	Monday Feb 23 at 11:30 AM	15%
Final Exam	TBA	40%
Total		100%

ACCREDITATION LEARNING OUTCOMES

The Learning Outcomes defined in this section are measured for Accreditation purposes only and will not be directly taken into consideration in determining a student's grade in the course.

Outcomes	Indicators
Identifies and states reasonable assumptions and suitable engineering fundamentals, before proposing a solution path to a problem	2.1
Proposes problem solutions supported by substantiated reasoning, recognizing the limitations of the solutions	2.2
Selects appropriately from relevant knowledge base to plan appropriate data collection methods and analysis strategies.	3.1
Synthesizes the results of an investigation to reach valid conclusions.	3.2
Successfully uses engineering tools	5.2

For more information on Accreditation, please visit: https://www.engineerscanada.ca

EQUITY, DIVERSITY, AND INCLUSION

Every registered student belongs in this course. Diversity of backgrounds and experiences is expected and welcome. You can expect your instructor to be respectful of this diversity in all aspects of the course, and the same is expected of you.

McMaster University is committed to creating an environment in which students of all genders, cultures, ethnicities, races, sexual orientations, abilities, and socioeconomic backgrounds have equal access to education and are welcomed and treated fairly. If you have any concerns regarding inclusion in our department, in particular if you or one of your peers is experiencing harassment or discrimination, you are encouraged to contact the Chair, Associate Chair (Undergraduate), Academic Advisor or the Equity and Inclusion Office.

MENTAL HEALTH & WELLNESS

For a list of McMaster University's resources, please refer to the Student Wellness Centre.
Talkspot is a non-crisis mental health resource specifically for students in the Faculty of Engineering.

ACADEMIC INTEGRITY

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity. It is your responsibility to understand what constitutes academic dishonesty.

Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university. For information on the various types of academic dishonesty please refer to the *Academic Integrity Policy*, located at https://secretariat.mcmaster.ca/university-policies-procedures-guidelines/

The following illustrates only three forms of academic dishonesty:
1. plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained.
2. improper collaboration in group work.
3. copying or using unauthorized aids in tests and examinations.

AUTHENTICITY / PLAGIARISM DETECTION

Some courses may use a web-based service (Turnitin.com) to reveal authenticity and ownership of student submitted work. For courses using such software, students will be expected to submit their work electronically either directly to Turnitin.com or via an online learning platform (e.g. A2L, etc.) using plagiarism detection (a service supported by Turnitin.com) so it can be checked for academic dishonesty.

Students who do not wish their work to be submitted through the plagiarism detection software must inform the Instructor before the assignment is due. No penalty will be assigned to a student who does not submit work to the plagiarism detection software. All submitted work is subject to normal verification that standards of academic integrity have been upheld (e.g., on-line search, other software, etc.). For more details about McMaster's use of Turnitin.com please go to www.mcmaster.ca/academicintegrity.

CONDUCT EXPECTATIONS

As a McMaster student, you have the right to experience, and the responsibility to demonstrate, respectful and dignified interactions within all of our living, learning and working communities. These expectations are described in the *Code of Student Rights & Responsibilities* (the "Code"). All students share the responsibility of maintaining a positive environment for the academic and personal growth of all McMaster community members, whether in person or online.

It is essential that students be mindful of their interactions online, as the Code remains in effect in virtual learning environments. The Code applies to any interactions that adversely affect, disrupt, or interfere with reasonable participation in University activities. Student disruptions or behaviours that interfere with university functions on online platforms (e.g. use of Avenue 2 Learn, WebEx or Zoom for delivery), will be taken very seriously and will be investigated. Outcomes may include restriction or removal of the involved students' access to these platforms.

ACADEMIC ACCOMMODATION OF STUDENTS WITH DISABILITIES

Students with disabilities who require academic accommodation must contact Student Accessibility Services (SAS) at 905-525-9140 ext. 28652 or sas@mcmaster.ca to make arrangements with a Program Coordinator. For further information, consult McMaster University's *Academic Accommodation of Students with Disabilities* policy.

COURSE POLICY ON MISSED WORK, EXTENSIONS, AND LATE PENALTIES

1. It is the students' responsibility to regularly check the course webpage (ex. Avenue to Learn) for updates and announcements.
2. The weight of any missed work that has been properly reported and approved using MSAF will be ***automatically added to the weight of the final examination***. No other accommodation will be provided for missed work.

SUBMISSION OF REQUEST FOR RELIEF FOR MISSED ACADEMIC WORK

In the event of an absence for medical or other reasons, students should review and follow the Academic Regulation in the Undergraduate Calendar "Requests for Relief for Missed Academic Term Work".

1. Relief for missed academic work worth less than 25% of the final grade resulting from medical or personal situations lasting up to three calendar days:

    - Use the McMaster Student Absence Form (MSAF) on-line self-reporting tool. No further documentation is required.
    - Students may submit requests for relief using the MSAF once per term.
    - An automated email will be sent to the course instructor, who will determine the appropriate relief. Students must immediately follow up with their instructors. Failure to do so may negate the opportunity for relief.
    - The MSAF cannot be used to meet a religious obligation or to celebrate an important religious holiday.
    - The MSAF cannot be used for academic work that has already been completed attempted.
    - An MSAF applies only to work that is due within the period for which the MSAF applies, i.e. the 3-day period that is specified in the MSAF; however, all work due in that period can be covered by one MSAF.
    - The MSAF cannot be used to apply for relief for any final examination or its equivalent. See *Petitions for Special Consideration* above.

2. For medical or personal situations lasting more than three calendar days, and/or for missed academic work worth 25% or more of the final grade, and/or for any request for relief in a term where the MSAF has been used previously in that term:

    - Students must report to their Faculty Office to discuss their situation and will be required to provide appropriate supporting documentation.
    - If warranted, the Faculty Office will approve the absence, and the instructor will determine appropriate relief.

ACADEMIC ACCOMMODATION FOR RELIGIOUS, INDIGENOUS OR SPIRITUAL OBSERVANCES (RISO)

Students requiring academic accommodation based on religious, indigenous or spiritual observances should follow the procedures set out in the RISO policy. Students should submit their request to their Faculty Office *normally within 10 working days* of the beginning of term in which they anticipate a need for accommodation or to the Registrar's Office prior to their examinations. Students should also contact their instructors as soon as possible to make alternative arrangements for classes, assignments, and tests.

COPYRIGHT AND RECORDING

Students are advised that lectures, demonstrations, performances, and any other course material provided by an instructor include copyright protected works. The Copyright Act and copyright law protect every original literary, dramatic, musical and artistic work, including lectures by University instructors

The recording of lectures, tutorials, or other methods of instruction may occur during a course. Recording may be done by either the instructor for the purpose of authorized distribution, or by a student for the purpose of personal study. Students should be aware that their voice and/or image may be recorded by others during the class. Please speak with the instructor if this is a concern for you.

Lectures and tutorials in ME4J03 will not be recorded. Students are expected to catch up any missed lectures and/or tutorials through the course notes and in-person help, as needed.

EXTREME CIRCUMSTANCES

The University reserves the right to change the dates and deadlines for any or all courses in extreme circumstances (e.g., severe weather, labour disruptions, etc.). Changes will be communicated through regular McMaster communication channels, such as McMaster Daily News, A2L and/or McMaster email.