

## Course Outline

# COMPUTATIONAL FLUID DYNAMICS

MECHENG 756  
Fall 2024

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### COURSE DESCRIPTION

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This course offers an exploration of Computational Fluid Dynamics (CFD), focusing on the simulation and analysis of fluid flow and heat transfer. Students will delve into the core principles of fluid mechanics, numerical methods, and the practical application of CFD for solving engineering challenges. The curriculum includes the formulation of governing equations, discretization techniques such as the Finite Volume Method (FVM), and approaches to solving both steady-state and transient problems. Practical sessions will provide hands-on experience with commercial CFD software, allowing students to model complex fluid dynamics scenarios and critically evaluate their results.

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### COURSE TIMETABLE AND LOCATION

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**Room Number:** JHE 323

**Time:** 1:30 pm to 4:30 pm

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### INSTRUCTIONAL SUPPORT

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**Instructor:** Kasra Ghasemi, PhD

**Email:** [Ghasek1@McMaster.ca](mailto:Ghasek1@McMaster.ca)

**Office Hours:** Send an email to schedule an in-person/virtual appointment

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### COURSE WEBSITE

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Avenue to Learn website (<http://avenue.mcmaster.ca/>) is used to administer the course. Students should be aware that, when they access the electronic components of this course, private information such as first and last names, usernames for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. Continuation in this course will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure, please discuss this with the course instructor.

The course will be delivered in person. All course information will be communicated through Avenue - it is your responsibility to regularly check the course webpage to stay apprised of course news and any changes in our delivery format.

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## LEARNING RESOURCES

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### Course Text Book:

S. Patankar, Numerical Heat Transfer and Fluid Flow. Boca Raton: CRC Press, 1980. doi: 10.1201/9781482234213.

### Other Useful Resources:

T. H. Pulliam and D. W. Zingg, Fundamental Algorithms in Computational Fluid Dynamics. in Scientific Computation. Cham: Springer International Publishing, 2014. doi: 10.1007/978-3-319-05053-9.

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## COURSE TOPICS

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The following topics will be covered in the course:

- **Mathematical Description of Physical Phenomena**
- **Discretization Methods**
- **Heat Conduction**
- **Convection and Diffusion**
- **Calculation of Flow Field**

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## ASSESSMENT

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Component	Weight
5 Assignments	Each 10%
Final Exam	50%

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## ASSESSMENT DETAILS

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### Assignments

Assignments are to be submitted individually to the assigned Dropbox folder in Avenue to Learn by the time specified. Graded assignments will be returned via the assignment return box. Once assignments have been returned, late submissions will no longer be accepted.

## Final Exam

A 2.5-hour final exam will be held in December (date TBD by the registrar). The final exam must be written or else a final grade of 'F' will be awarded with the notation Did Not Write. The standard 'numeric to letter grade' conversion will be used to assign the appropriate letter grade at the end of the course.

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## EQUITY, DIVERSITY, AND INCLUSION

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The Faculty of Engineering is concerned with ensuring an environment that is free of all discrimination. If there is a problem that cannot be resolved by discussion among the persons concerned, individuals are reminded that they should contact the Department Chair, the Sexual Harassment Officer or the Human Rights Consultant, as the problem occurs.

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.

The Department of Engineering Physics 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 Undergraduate Chair, Academic Advisor or to contact the [Equity and Inclusion Office](#).

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## PHYSICAL AND MENTAL HEALTH

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For a list of McMaster University's resources, please refer to the [Student Wellness Centre](#).

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## ACADEMIC INTEGRITY

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Students are reminded that they should read and comply with the Statement on Academic Ethics and the Senate Resolutions on Academic Dishonesty as found in the Senate Policy Statements distributed at registration and available at the Senate Office. While interaction with your fellow students is expected in learning the course, assignments and projects submitted for academic credit must be your own work.

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. The 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](https://secretariat.mcmaster.ca/university-policies-proceduresguidelines/), located at <https://secretariat.mcmaster.ca/university-policies-proceduresguidelines/>

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.

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## **AUTHENTICITY / PLAGIARISM DETECTION**

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This course may use a web-based service (Turnitin.com) to reveal the 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/](http://www.mcmaster.ca/academicintegrity/).

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## **COURSES WITH AN ON-LINE ELEMENT**

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McMaster is committed to an inclusive and respectful community. These principles and expectations extend to online activities including electronic chat groups, video calls and other learning platforms.

This course uses on-line elements (e.g., e-mail, Avenue to Learn (A2L), etc.). Students should be aware that, when they access the electronic components of a course using

these elements, private information such as first and last names, usernames for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in a course that uses on-line elements will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure, please discuss this with the course instructor.

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## **ONLINE PROCTORING**

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This course may use online proctoring software for tests and exams. This software may require students to turn on their video camera, present identification, monitor and record their computer activities, and/or lock/restrict their browser or other applications/software during tests or exams. This software may be required to be installed before the test/exam begins.

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## **CONDUCT EXPECTATIONS (THE “COMMON SENSE” CLAUSE)**

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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.

In other words, everyone please be respectful and kind - we are all here to learn.

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## **ACADEMIC ACCOMMODATION OF STUDENTS WITH DISABILITIES**

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

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## **COURSE POLICY ON MISSED WORK, EXTENSIONS, AND LATE PENALTIES**

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1. It is the student's responsibility to regularly check the course webpage (e.g., Avenue to Learn) for updates and announcements related to this course.
2. All submissions are due at midnight (specifically, 11:59 PM on the due date)
3. Arrangements be made with the Instructor prior to any missed work/extensions/late submissions. Exceptions may be made regarding unforeseeable situations.
4. Late penalties will be applied at the instructor's discretion.

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## **SUBMISSION OF REQUEST FOR RELIEF FOR MISSED ACADEMIC WORK**

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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.

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

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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 the 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.

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## **COPYRIGHT AND RECORDING**

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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.

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## **EXTREME CIRCUMSTANCES**

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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.