McMaster University | Civil Engineering

# 2023-24 COURSE OUTLINE

## COURSE INFORMATION

**Course Name:** Computer Applications in Civil Engineering **Course Code:** CIVENG 2E03
**Session Offered:** Fall 2023
**Calendar Description:** 3 unit(s)
Numerical techniques including error analysis, root finding, linear algebraic equations, curve fitting, integration and differentiation, ordinary differential equations; sensitivity analysis; use of several software packages for numerical analysis; civil engineering applications.
Two lectures, one lab, one tutorial; first term

**Prerequisite(s):** Credit or registration in CIVENG 2P04

**Instructor:** Dr. Feras Alsheet Phone: 647-979-1058
Email: sheitf1@mcmaster.ca Office Hours/Contact: TBD (by Email)

**Class Schedule:**
**Lectures:** Tu & We 12:30PM - 1:20PM
**Tutorials:** Fr 12:30PM - 2:20PM (T01) Mo 2:30PM - 4:20PM (T02)
**Labs:** Mo 12:30PM - 1:20PM (L01) Mo 9:30AM - 10:20AM (L02)
Tu 8:30AM - 9:20AM (L03)
**Textbook (Recommended):** Numerical Methods for Engineers, 8th Edition, Chapra & Canale – McGraw-Hill
**TAs:** Abdul Razak Alozi (alozia@mcmaster.ca); Mahtab Masouminia (masoumm@mcmaster.ca);
Yuhang Gu (gu1@mcmaster.ca)

## 1. COURSE OBJECTIVES

Learn the basic principles of modelling mathematical problems that occur in engineering; understand the main tools available in numerical analysis; write MATLAB programs that use numerical methods to solve engineering problems; numerical techniques including error analysis, root finding, linear algebraic equations, curve fitting, integration and differentiation, ordinary differential equations; sensitivity analysis; civil engineering applications.

## 2. COURSE SPECIFIC POLICIES

Accommodations for missed academic work with a granted relief (further details are given in section 7 of this outline) are as follows:
1. Midterms/Quizzes: there will be no makeup test and the missed midterm/tutorial-quiz grade portion will be re-allocated to the final examination.
2. Assignments will be extended by the same length of the absence.
Late assignment submissions with no granted relief: the assignment grade will be reduced by 20% per each late day. Late assignments that are submitted after 5 days from the deadline will not be accepted.
3. The following course schedule is tentative. The instructor and the University reserve the right to modify elements of the course during the term. Any changes you will be announced in class and/or posted on A2L.

| 3. SCHEDULE | | |
|---|---|---|
| WEEK 1 | Introduction: Modelling and Computers | Chapters 1 & 2 |
| WEEK 2 | Number Representation and Errors | Chapters 3 & 4 |
| WEEK 3 | Root Finding: Bracketing Methods<br>• Bisection Method<br>• False Position | Chapter 5 |
| WEEK 4 | Root Finding: Open Methods<br>• Newton-Raphson<br>• Secant Method | Chapter 6 |
| WEEK 5 | Systems of Linear Equations<br>• Gauss Elimination<br>• Gauss-Jordan | Chapter 9 |
| WEEK 6 | Systems of Linear Equations<br>• LU Decomposition<br>• Gauss-Seidel | Chapters 10 &11 |
| WEEK 7 | Least Squares Regression<br>• Polynomial Regression<br>• Multiple Linear Regression | Chapter 17 |
| WEEK 8 | Polynomial Interpolation<br>• Lagrange Interpolating Polynomials<br>• Spline Functions | Chapter 18 |
| WEEK 9 | Numerical Integration<br>• Trapezoidal Rule<br>• Simpson's Rule | Chapter 21 |
| WEEK 10 | Numerical Integration<br>• Romberg Algorithm<br>• Gauss Quadrature | Chapter 22 |
| WEEK 11 | Numerical Differentiation<br>• First Derivative via Taylor Series<br>• Second Derivative via Taylor Series<br>Richardson Extrapolation | Chapter 23 |
| WEEK 12 | First Order ODE<br>• Taylor Series Method<br>• Runge-Kutta Methods | Chapter 25 |
| WEEK 13 | Systems of First Order ODE; Higher Order ODE<br>• Runge-Kutta Methods<br>• Review | Chapter 25 |
| FINAL EXAMINATION | Scheduled during the regular University Final Examination period established by The Registrar's Office | FINAL EXAMINATION |

| 4. ASSESSMENT OF LEARNING | WEIGHT % |
|---|---|
| Lab Assignments | 20 % |
| Tutorial Assignments | 20 % |
| Major Assignments | 20 % |
| Final Exam | 40 % |
| Total | 100 % |

## 5. LEARNING OUTCOMES (CEAB ATTRIBUTES AND INDICATORS)

**When you have successfully completed this course, you will be able to:**

- Select appropriately from relevant knowledge base to plan appropriate data collection methods and analysis strategies.
- Define the problem by identifying relevant context, constraints, and prior approaches before exploring potential design solutions.
- Succesfully use engineering tools.

**To attain the learning outcomes stated above we will:**

- Learn the basic principles of modelling mathematical problems that occur in engineering
- Understand the main tools available in numerical analysis
- Write MATLAB programs that use numerical methods to solve engineering problems
- Become familiar with numerical techniques including error analysis, root finding, linear algebraic equations, curve fitting, integration and differentiation, ordinary differential equations
- Apply numerical techniques to various civil engineering applications

**Graduate Attributes and CEAB Indicators**

1. A03 INVESTIGATION – 3.1 Selects appropriately from relevant knowledge base to plan appropriate data collection methods and analysis strategies.
2. A04 DESIGN - 4.1 Defines the problem by identifying relevant context, constraints, and prior approaches before exploring potential design solutions.
3. A05 USE OF ENGINNEERING TOOLS - 5.2 Succesfully uses engineering tools.

## 6. LABORATORY SAFETY

The Faculty of Engineering is committed to McMaster University's Workplace and Environmental Health and Safety Policy which states: "Students are required by University policy to comply with all University health, safety and environmental programs and policies". It is your responsibility to understand McMaster University's Risk Management system, which is supported by a collection of Risk Management Manuals (RMMs) that contain programs and policies in support of the Risk Management System. The RMMs are available from https://hr.mcmaster.ca/employees/health_safety_well-being/our-safety/risk-management-manuals-rmms/.

It is also your responsibility to follow any specific Standard Operating Procedures (SOPs) provided for specific experiments (see course lab manuals) and the laboratory equipment https://www.eng.mcmaster.ca/sites/default/files/civil_lab_health_and_safety_manual.pdf

Additionally, McMaster University's workplace health and safety guidance related to COVID-19 must always be followed (available from https://hr.mcmaster.ca/resources/covid19/workplace-health-and-safety-guidance-during-covid-19/).

Students not abiding by these safety requirements will be given one warning. Second offences will result in the student being asked to vacate the laboratory and receiving a grade of zero for that particular lab.

## 7. COMMUNICATIONS

It is the student's responsibility to:

- Maintain current contact information with the University, including address, phone numbers, and emergency contact information.
- Use the University provided e-mail address or maintain a valid forwarding e-mail address.
- Regularly check the official University communications channels. Official University communications are considered received if sent by postal mail, by fax, or by e-mail to the student's designated primary e-mail account via their "@mcmaster.ca" alias.
- Accept that forwarded e-mails may be lost and that e-mail is considered received if sent via the student's @mcmaster.ca alias.

Check the McMaster/Avenue email and course websites on a regular basis during the term.

## 8. POLICIES

### 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:

- plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained.
- improper collaboration in group work.
- 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.

### COURSES WITH AN ON-LINE ELEMENT

Some courses may use on-line elements (e.g. e-mail, Avenue to Learn (A2L), LearnLink, web pages, capa, Moodle, ThinkingCap, 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, user names 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.

**ONLINE PROCTORING**

Some courses 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.

**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.

**REQUESTS FOR RELIEF FOR MISSED ACADEMIC TERM WORK**

McMaster Student Absence Form (MSAF): 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".

The McMaster Student Absence Form is a self-reporting tool for Undergraduate Students to report absences that last up to 5 days and provides the ability to request accommodation for any missed academic work. Please note, this tool cannot be used during any final examination period. You may submit a maximum of 1 Academic Work Missed requests per term. It is your responsibility to follow up with your Instructor immediately regarding the nature of the accommodation. If you are absent more than 5 days or exceed 1 request per term you must visit your Associate Dean's Office (Faculty Office). You may be required to provide supporting documentation.

This form should be filled out immediately when you are about to return to class after your absence.

**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.

**PROTECTION OF PRIVACY ACT (FIPPA)**

The Freedom of Information and Protection of Privacy Act (FIPPA) applies to universities. Instructors should take care to protect student names, student numbers, grades, and all other personal information at all times. For example, the submission and return of assignments and the posting of grades must be done in a manner that ensures confidentiality – see http://www.mcmaster.ca/univsec/fippa/fippa.cfm.

**ANTI-DISCRIMINATION**

The Faculty of Engineering is concerned with ensuring an environment that is free of all discrimination. If there is a problem, individuals are reminded that they should contact the Department Chair, the Sexual Harassment Officer, or the Human Rights Consultant, as soon as possible.
https://www.mcmaster.ca/policy/General/HR/Discrimination_and_Harassment.pdf

**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.

## 9. MCMASTER GRADING SCALE

| Grade | Equivalent Grade Point | Equivalent Percentages |
|---|---|---|
| A+ | 12 | 90-100 |
| A | 11 | 85-89 |
| A- | 10 | 80-84 |
| B+ | 9 | 77-79 |
| B | 8 | 73-76 |
| B- | 7 | 70-72 |
| C+ | 6 | 67-69 |
| C | 5 | 63-66 |
| C- | 4 | 60-62 |
| D+ | 3 | 57-59 |
| D | 2 | 53-56 |
| D- | 1 | 50-52 |
| F | 0 | 0-49 |