

Course Outline

1. COURSE INFORMATION

Session Offered	Winter 2021	
Course Name	Modelling and Numerical Solutions	
Course Code	ENGTECH 2MS3	
Date(s) and Time(s) of lectures	Fri 8:30am-10:30am, 11:30am-12:30pm C01, 12:30pm-1:30pm C02, 1:30pm-2:30pm C03	
Program Name	Automotive and Vehicle Engineering Technology	
Calendar Description	Number systems and errors; solutions to nonlinear equations; interpolation by polynomials; matrices and systems of linear equations; differentiation and integration; differential equations; applications to mechanical systems.	
Instructor(s)	Dr. Lucian Balan	E-Mail: balanl@avenue.cilmcmaster.ca Office: on-line course

2. COURSE SPECIFICS

Course Description	Base number conversions; floating point representation; simple and double precision; computational error analysis; iterative methods to find roots of equations using bisection and Regula Falsi bracketing methods, as well as Newton-Raphson and secant iteration methods, discuss advantages and disadvantages; solve linear algebraic equations using Gaussian elimination and LU de-factorization; calculate polynomial and spline interpolation with Lagrange's and Newton's methods; compute integral using upper and lower sums, trapezoid rule, and Romberg algorithms; compute numerical solutions for first-order ordinary differential equation with initial condition using Taylor series and Runge-Kutta methods; decompose a set of higher-order ordinary differential equations into a simultaneous set of first-order ordinary differential equations and solve the system using numerical methods; develop C++ source codes to implement these methods		
Instruction Type	Code	Type	Hours per term
	C	Classroom instruction	36
	L	Laboratory, workshop or fieldwork	
	T	Tutorial	
	DE	Distance education	
	Total Hours		36
Resources	ISBN	Textbook Title & Edition	Author & Publisher
	7 th Ed: 978-1133103714 6 th Ed: 9780495114758	Numerical Mathematics and Computing, 7th Ed. (or 6th Ed.)	Cheney, W and D. Kincaid,
	Other Supplies	Source	
	USB flash drive	Students must provide their own USB flash drive 2+GB	
Prerequisite(s)	ENGTECH 1CP3, ENGTECH 1MT3, and registration in Level II of Automotive and Vehicle Engineering Technology		
Corequisite(s)	N/A		
Antirequisite(s)	CIVTECH 3MN3, ENGTECH 2MN3, ENGTECH 3MN3		

<p>Course Specific Policies</p>	<ul style="list-style-type: none"> ○ This course will be delivered on-line. E-mail communication with instructor for this course is through Avenue Mail (balanl@avenue.cilmcmaster.ca) ○ Students must provide their own USB flash drive with enough space for storing their in-class course work. No student work should be left on lab computers. ○ Licensed software is provided in computer lab. The university is not responsible for providing individual software licenses to students or for installation support of the software on personal laptops. ○ The computer lab has remote access intervals during regular hours to allow students to complete their homework. ○ Some assignments require submission of manual calculations and programming results in a specific template provided by the instructor, as well as the corresponding C++ source code. The work submitted must reflect student’s own work. ○ Assignments must be submitted by due dates posted on Avenue. Once an assignment solution is posted, or discussed in the class, late submissions cannot be accepted. If an “msaf” is submitted for an assignment after the solution was disclosed, the student must contact the instructor immediately to discuss accommodation. ○ Students may use their own laptops to complete coursework as long as their submitted files are compatible with software versions installed in the lab. The instructor will not attempt to convert any work submitted in a wrongful format. ○ If issues are encountered with on-line submissions on Avenue, students should email the instructor immediately with attached completed work as proof. At the earliest lab time, the instructor will allow for proper submission of emailed work. ○ For assignment portion of the evaluation, the instructor may decide to drop one of the assignment marks, the lowest, after all assignments were completed. In such a case, if an msaf is submitted for an assignment, that assignment will be considered as the dropped mark. ○ A paper, outlining major formulas, will be provided for the mid-term test and final exam. Other resources are not permitted during the tests unless specifically stated. ○ Some of the C++ codes submitted as assignments may be required during the midterm test or final exam, as indicated by the instructor. Should a student did not submit one of these assignments, a pseudo-code will be made available at test/exam time to create the missing code.
<p>Departmental Policies</p>	<p>Students must maintain a GPA of 3.5/12 to continue in the program.</p> <p>In order to achieve the required learning objectives, on average, B.Tech. students can expect to do at least 3 hours of “out-of-class” work for every scheduled hour in class. “Out-of-class” work includes reading, research, assignments and preparation for tests and examinations.</p> <p>Where group work is indicated in the course outline, such collaborative work is mandatory.</p> <p>The use of cell phones, iPods, laptops and other personal electronic devices are prohibited from the classroom during the class time, unless the instructor makes an explicit exception.</p>

	<p>Announcements made in class or placed on Avenue are considered to have been communicated to all students including those individuals that are not in class.</p> <p>Instructor has the right to submit work to software to identify plagiarism.</p>	
3. SUB TOPIC(S)		
Week 1	<p>Modeling and Computers; Number Representation and Errors.</p> <ul style="list-style-type: none"> ○ Representations of numbers in different basis ○ Floating point representation ○ Loss of significance 	Ch.2
Week 2	<p>Roots of Non-linear Functions</p> <ul style="list-style-type: none"> ○ Bisection method ○ False position method ○ Newton's method ○ Secant method 	Ch.3
Week 3	<p>Systems of Linear Equations</p> <ul style="list-style-type: none"> ○ Naïve Gaussian elimination ○ Gaussian elimination with scaled partial pivoting 	Ch.7
Week 4	<p>Polynomial Interpolation</p> <ul style="list-style-type: none"> ○ Curve fitting. ○ Lagrange form of the interpolation polynomial ○ Newton form of the interpolation polynomial ○ Divided differences 	Ch.4
Week 5	Engineering Applications – <i>Review</i>	
Week 6	<i>Mid-term test, Quiz 1</i>	
Week 7	<p>Spline Functions</p> <ul style="list-style-type: none"> ○ First-degree splines ○ Quadratic splines ○ Normal cubic splines 	Ch.9
Week 8	<p>Numerical Integration</p> <ul style="list-style-type: none"> ○ Lower and upper sums ○ Trapezoid rule ○ Romberg Algorithm 	Ch.5
Week 9	<p>First Order ODE</p> <ul style="list-style-type: none"> ○ Taylor-series method ○ Runge-Kutta method 	Ch.10
Week 10	<p>Systems of First Order ODEs</p> <ul style="list-style-type: none"> ○ Taylor-series method ○ Runge-Kutta methods 	Ch.11
Week 11	<p>Higher Order ODE and Systems of Higher Order ODEs</p> <ul style="list-style-type: none"> ○ Convert higher order ODEs into a system of first order ODEs ○ Convert systems of higher order ODEs into multiple systems of first order ODEs 	Ch.11
Week 12	Engineering Applications – <i>Review, Quiz 2</i>	
Week 13	N/A	

Midterm Recess: Monday, February 15 to Sunday, February 21
 Classes end: Wednesday, April 14
 Final Examination Period: Thursday, April 15 to Friday, April 30
 All examinations MUST be written during the scheduled examination period.

Note that this structure represents a plan and is subject to adjustment term by term.
 The instructor and the University reserve the right to modify elements of the course during the term. The University may change the dates and deadlines for any or all courses in extreme circumstances. If either type of modification becomes necessary, reasonable notice and communication with the students will be given with explanation and the opportunity to comment on changes.

4. ASSESSMENT OF LEARNING *including dates*	Weight
Quizzes (two) – week 6, 12	15%
Assignments (eight) – week 1,2,3,4,7,8,9,10	15%
Mid-term test - week 7	30%
Final examination (tests cumulative knowledge)	40%
TOTAL	100%

Percentage grades will be converted to letter grades and grade points per the University calendar.

5. LEARNING OUTCOMES

1. Understand the limitations of iterative computation methods when implemented in computer programs
2. Construct numerical solutions to engineering problems in a format that emphasizes insight into engineering, not just the presentation of numbers.
3. Compare and analyze various numerical computation methods used in solving engineering and technology problems
4. Evaluate and recommend the most appropriate approach for solving engineering problems using iterative computations
5. Perform error analyses and determine if the solutions are acceptable
6. Implement various numerical computation methods into C++ programs

6. COURSE OUTLINE – APPROVED ADVISORY STATEMENTS

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.

http://www.mcmaster.ca/policy/General/HR/Discrimination_Harassment_Sexual_Harassment-Prevention&Response.pdf

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: 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.

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.

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”.

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. <http://www.mcmaster.ca/policy/Students-AcademicStudies/Studentcode.pdf>

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.

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.