

## Course Outline

### 1. COURSE INFORMATION

<b>Session Offered</b>	Winter 2017	
<b>Course Name</b>	Modelling and Numerical Solutions	
<b>Course Code</b>	ENG TECH 2MS3	
<b>Date(s) and Time(s) of lectures</b>	Tuesdays 4:30pm-5:30pm, 5:30pm-6:30pm Jan 4, 2015 – Apr 6, 2017	
<b>Program Name</b>	Automotive and Vehicle Technology	
<b>Calendar Description</b>	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.	
<b>Instructor(s)</b>	Dr. Lucian Balan	Phone: MARC 289-674-0250 ext.59102 E-Mail: Avenue Email Office: MARC 271

### 2. COURSE SPECIFICS

<b>Course Description</b>	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		
<b>Instruction Type</b>	<b>Code</b>	<b>Type</b>	<b>Hours per term</b>
	C	Classroom instruction	36
	L	Laboratory, workshop or fieldwork	
	T	Tutorial	
	DE	Distance education	
	<b>Total Hours</b>		36
<b>Resources</b>	<b>ISBN</b>	<b>Textbook Title &amp; Edition</b>	<b>Author &amp; Publisher</b>
	7 <sup>th</sup> Ed: 978-1133103714 6 <sup>th</sup> Ed: 9780495114758	Numerical Mathematics and Computing, 7 <sup>th</sup> Ed. (or 6 <sup>th</sup> Ed.)	Cheney, W and D. Kincaid, Thomson - Brooks/Cole
	<b>Other Supplies</b>	<b>Source</b>	
	USB flash drive	Students must provide their own USB flash drive (2 GB or more)	
<b>Prerequisite(s)</b>	ENGTECH 1CP3, ENGTECH 1MT3, and registration in Level II of Automotive and Vehicle Technology		
<b>Corequisite(s)</b>	N/A		

<b>Antirequisite(s)</b>	CIVTECH 3MN3, ENG TECH 2MN3, <u>ENGTECH 3MN3</u>	
<b>Course Specific Policies</b>	<ul style="list-style-type: none"> <li>○ E-mail communication for this course through Avenue Email (instructor included in class list)</li> <li>○ Some assignments may require Avenue submission of manual calculations and programming results in a specific template provided by the instructor, along with the corresponding C++ source code. Assignment results submitted without the C++ part (where applicable) will be marked with zero.</li> <li>○ The work submitted must reflect student's own work. For in-class work submissions students must attend the corresponding labs.</li> <li>○ Late assignments will not be accepted for grading after the solution has been posted on Avenue, or discussed in class. Assignment grading will be done on random picks of submitted work.</li> <li>○ There will be no make-up assignments. For the assignment portion of your evaluation, the instructor may decide on dropping one of the assignment marks. If this is the case, it will occur at the end of semester after all assignments have been completed. NOTE: If an MSAF is submitted for an assignment, that assignment is considered as the dropped mark</li> <li>○ Students must bring a USB flash drive with them at all lab sessions, and keep a copy of their course work (excl. tests, exams, quizzes). Weekly back-ups are recommended.</li> <li>○ A paper, outlining major formulas, will be provided for the mid-term test and final exam. Worked examples and written text are not permitted to be used during the tests unless specifically stated.</li> <li>○ Some C++ codes of submitted assignments may be required to be used during the midterm test or final exam, as indicated by the instructor. Should a student did not submit one of these assignment codes by due date, corresponding pseudo-code will be made available at test/exam time to create missing code.</li> <li>○ All tests (mid-terms, final exam) must be performed on existing lab computers. Midterm tests may be scheduled outside of regular class hours.</li> <li>○ All required work must be shown to get full credit for the course. Missed coursework will not be prorated to the final exam grade.</li> </ul>	
<b>Departmental Policies</b>	<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>	
<b>3. SUB TOPIC(S)</b>		
Week 1	Modeling and Computers; Number Representation and Errors.	

	<ul style="list-style-type: none"> <li>○ Representations of numbers in different basis</li> </ul>	Ch.2
Week 2	Modeling and Computers; Number Representation and Errors. <ul style="list-style-type: none"> <li>○ Floating point representation</li> <li>○ Loss of significance</li> </ul>	Ch.2
Week 3	Roots of Non-linear Functions <ul style="list-style-type: none"> <li>○ Bisection method</li> <li>○ False position method</li> <li>○ Newton's method</li> <li>○ Secant method</li> </ul>	Ch.3
Week 4	Systems of Linear Equations <ul style="list-style-type: none"> <li>○ Naïve Gaussian elimination</li> <li>○ Gaussian elimination with scaled partial pivoting</li> <li>○ LU factorization</li> </ul>	Ch.7
Week 5	Polynomial Interpolation <ul style="list-style-type: none"> <li>○ Curve fitting.</li> <li>○ Lagrange form of the interpolation polynomial</li> <li>○ Newton form of the interpolation polynomial</li> <li>○ Divided differences</li> </ul>	Ch.4
Week 6	Spline Functions <ul style="list-style-type: none"> <li>○ First-degree splines</li> <li>○ Quadratic splines</li> <li>○ Normal cubic splines</li> </ul>	Ch.9
Week 7	Engineering Applications – <i>Review</i> <ul style="list-style-type: none"> <li>○ <i>Mid-term test</i></li> </ul>	
Mid-term Recess: Monday, February 20 to Sunday, February 26, 2017		
Week 8	Numerical Integration <ul style="list-style-type: none"> <li>○ Lower and upper sums</li> <li>○ Trapezoid rule</li> <li>○ Romberg Algorithm</li> </ul>	Ch.5
Week 9	First Order ODE <ul style="list-style-type: none"> <li>○ Taylor-series method</li> <li>○ Runge-Kutta method</li> </ul>	Ch.10
Week 10	Systems of First Order ODE (part 1) <ul style="list-style-type: none"> <li>○ Taylor-series method</li> </ul>	Ch.11
Week 11	Systems of First Order ODE (part 2) <ul style="list-style-type: none"> <li>○ Runge-Kutta methods</li> </ul>	Ch.11
Week 12	Higher Order ODE <ul style="list-style-type: none"> <li>○ Convert higher order ODEs to a system of first order ODEs</li> </ul>	Ch.11
Week 13	Engineering Applications – <i>Review</i>	
Classes end: Thursday, April 6, 2017 Final examination period: Tuesday, April 11 to Thursday, April 27, 2016 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.		
<b>4. ASSESSMENT OF LEARNING *including dates*</b>		<b>Weight</b>
Quizzes / Assignments (random picks) – every week		20%

Mid-term test	35%
Final examination – <i>Examination period</i>	45%
<b>TOTAL</b>	<b>100%</b>
Percentage grades will be converted to letter grades and grade points per the University calendar.	
<b>5. LEARNING OUTCOMES</b>	
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	
<b>6. POLICIES</b>	
<b>Anti-Discrimination</b>	
<p>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.</p> <p><a href="http://www.mcmaster.ca/policy/General/HR/Discrimination_Harassment_Sexual_Harassment-Prevention&amp;Response.pdf">http://www.mcmaster.ca/policy/General/HR/Discrimination_Harassment_Sexual_Harassment-Prevention&amp;Response.pdf</a></p>	
<b>Academic Integrity</b>	
<p>You are required to exhibit honestly and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity.</p> <p>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.</p> <p>It is your responsibility to understand what constitutes academic dishonesty. For information on the various kinds of academic dishonesty please refer to the Academic Integrity Policy, located at: <a href="http://www.mcmaster.ca/policy/Students-AcademicStudies/AcademicIntegrity.pdf">http://www.mcmaster.ca/policy/Students-AcademicStudies/AcademicIntegrity.pdf</a> .</p> <p>The following illustrates only three forms of academic dishonesty:</p> <ol style="list-style-type: none"> <li>1. Plagiarism. E.g. the submission of work that is not own or for which other credit has been obtained</li> <li>2. Improper collaboration in group work</li> <li>3. Copying or using unauthorized aids in tests and examinations.</li> </ol>	
<b>Requests for Relief for Missed Academic Term Work (Assignments, Mid-Terms, etc.)</b>	
<p>The McMaster Student Absence Form is an on-line self-reporting tool for <b>Undergraduate Students</b> to report absences for:</p> <ol style="list-style-type: none"> <li>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: <ul style="list-style-type: none"> <li>• Students may submit a maximum of one academic work missed request per term. It is the responsibility of the student to follow up with instructors immediately (within the 3 day period that is specified in the MSAF) regarding the nature of the accommodation. All work due in that time period however can be covered by one MSAF.</li> <li>• MSAF cannot be used to meet religious obligation or celebration of an important religious holiday, for that has already been completed or attempted or to apply for relief for any final examination or its equivalent.</li> </ul> </li> </ol>	

- 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 not been used previously in that term:
- Students must visit their Associate Dean's Office (Faculty Office) and provide supporting documentation.

### **E-Learning Policy**

Consistent with the Bachelor of Technology's policy to utilize e-learning as a complement to traditional classroom instruction, students are expected to obtain appropriate passwords and accounts to access Avenue To Learn for this course. Materials will be posted by class for student download. It is expected that students will avail themselves of these materials prior to class. Students should be aware that, when they access the electronic components of this course, private information such as first and last names, user names for the McMaster e-mail account, and program affiliation may become apparent to all other students in the course. The available information is dependent on the technology used. Continuation in this course will be deemed consent to this disclosure. If you have any questions or concerns about this disclosure please discuss this with the course instructor. Avenue can be accessed via <http://avenue.mcmaster.ca>.

### **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.

### **Turnitin (Optional)**

This course will be using a web-based service (Turnitin.com) to reveal plagiarism. Students submit their assignment/work electronically to Turnitin.com where it is checked against the internet, published works and Turnitin's database for similar or identical work. If Turnitin finds similar or identical work that has not been properly cited, a report is sent to the instructor showing the student's work and the original source. The instructor reviews what Turnitin has found and then determines if he/she thinks there is a problem with the work. Students who do not wish to submit their work to Turnitin.com must still submit a copy to the instructor. No penalty will be assigned to a student who does not submit work to Turnitin.com. All submitted work is subject to normal verification that standards of academic integrity have been upheld (e.g., on-line search, etc.). To see the Turnitin.com Policy, please go to <http://www.mcmaster.ca/academicintegrity/turnitin/students/>

### **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 posting of grades must be done in a manner that ensures confidentiality. <http://www.mcmaster.ca/univsec/fippa/fippa.cfm>

### **Academic Accommodation of Students with Disabilities Policy**

Students who require academic accommodation must contact Student Accessibility Services (SAS) to make arrangements with a Program Coordinator. Academic accommodations must be arranged for each term of study. Student Accessibility Services can be contacted by phone 905-525-9140 ext. 28652 or e-mail [sas@mcmaster.ca](mailto:sas@mcmaster.ca). For further information consult McMaster's policy for Academic Accommodation of Students with Disabilities

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

Students must forward a copy of the SAS accommodation to the instructor of each course and to the Program Administrator of the B.Tech. Program immediately upon receipt. If a student with a disability chooses NOT to take advantage of a SAS accommodation and chooses to sit for a regular exam, a petition for relief may not be filed after the examination is complete. <http://sas.mcmaster.ca>

### **Student Code of Conduct**

The Student Code of Conduct (SCC) exists to promote the safety and security of all the students in the McMaster community and to encourage respect for others, their property and the laws of the land. McMaster University is a community which values mutual respect for the rights, responsibilities, dignity and well-being of others. The purpose of the Student Code of Conduct is to outline accepted standards of behavior that are harmonious with the goals and the well-being of the University community, and to define the procedures to be followed when students fail to meet the accepted standards of behavior. All students have the responsibility to familiarize themselves with the University regulations and the conduct expected of them while studying at McMaster University.

[http://studentconduct.mcmaster.ca/student\\_code\\_of\\_conduct.html](http://studentconduct.mcmaster.ca/student_code_of_conduct.html)