CIV ENG 2E03 Course Outline

1. COURSE INFORMATION

<table>
<thead>
<tr>
<th>Session Offered</th>
<th>Fall 2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Name</td>
<td>Computer Applications in Civil Engineering</td>
</tr>
<tr>
<td>Course Code</td>
<td>Civ Eng 2E03</td>
</tr>
<tr>
<td>Calendar Description</td>
<td>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.</td>
</tr>
</tbody>
</table>

Instructor(s) Cameron Churchill  
Phone: x23179  
E-Mail: church@mcmaster.ca  
Office Hours & Location: JHE 233/A

2. COURSE SPECIFICS

Course Description
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.

<table>
<thead>
<tr>
<th>Instruction Type</th>
<th>Code</th>
<th>Type</th>
<th>Hours per term</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C</td>
<td>Classroom instruction</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>L</td>
<td>Laboratory, workshop or fieldwork</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>T</td>
<td>Tutorial</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>DE</td>
<td>Distance education</td>
<td></td>
</tr>
</tbody>
</table>

Total Hours 58

Resources
ISBN 978-0073397924  
Author & Publisher Chapra & Canale – McGraw-Hill

Other Supplies Source

Course Specific Policies
- Late assignments will not be accepted
- Term tests and Final Exams will be closed-book.
- One FORMULA ONLY crib sheet will be allowed for each test
- Only the use of the McMaster Standard Calculator will be allowed on the test and final exam

3. SUB TOPIC(S)

Week 1  
Introduction, Modelling and Computers;  
Chapters 1 and 2

Week 2  
Number Representation and Errors Root Finding: Bracketing Methods  
- Graphical  
- Bisection Method  
- False Position

Week 3  
Root Finding: Open Methods  
- Newton-Raphson  
- Secant Method

Week 4  
Root Finding: Open Methods  
- Muller’s Method  
Chapter 7  
Chapter 9
<table>
<thead>
<tr>
<th>Week</th>
<th>Topics</th>
<th>Chapter(s)</th>
</tr>
</thead>
</table>
| 5    | Systems of Linear Equations  
• Gauss Elimination  
• Gauss-Jordan | 10, 11 |
| 6    | Systems of Linear Equations  
• LU Decomposition  
• Gauss-eidel  
Least Squares Regression  
• Linear Regression | 17 |
| 7    | Least Squares Regression  
• Polynomial Regression  
• Multiple Linear Regression  
Polynomial Interpolation  
• Lagrange Interpolating Polynomials | 18 |
| 8    | Polynomial Interpolation  
• Lagrange Interpolating Polynomials  
Spline Functions  
• First Degree Splines  
• Second Degree Splines  
• Cubic Splines | 18 |
| 9    | Numerical Integration  
• Trapezoidal Rule  
• Romberg Algorithm | 21 |
| 10   | Numerical Integration  
• Simpson’s Rule  
• Gauss Quadrature | 22 |
| 11   | Numerical Differentiation  
• First Derivative via Taylor Series  
• Second Derivative via Taylor Series  
• Richardson Extrapolation | 23 |
| 12   | First Order ODE  
• Taylor Series Method  
• Runge-Kutta Methods | 25 |
| 13   | Systems of First Order ODE; Higher Order ODE  
• Runge-Kutta Methods  
• Review | 25 |
|      | Final Examination |  |

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

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quizzes</td>
<td>20%</td>
</tr>
<tr>
<td>Term Tests (three 1-hour tests, each worth 10%)</td>
<td>30%</td>
</tr>
<tr>
<td>Final Exam</td>
<td>50%</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>
Course results determined on a percentage scale will be converted to an official letter grade, as indicated in the Undergraduate Calendar. The results of all courses attempted will appear on your transcript as letter grades.

5. **LEARNING OUTCOMES**

1. Perform error analyses and determine if the solutions are acceptable. [CEAB Indicator(s): 1.1, 2.1, 2.3, 3.1, 3.3, 5.1]

2. Understand the limitations of the numerical techniques covered. [CEAB Indicator(s): 1.1, 2.2, 2.3, 3.2, 5.1]

3. Distinguish between and select the most applicable of available numerical techniques for an engineering analysis task. [CEAB Indicator(s): 1.1, 2.2, 3.2, 5.1]

4. Use software packages (spreadsheet tools such as MS Excel and programming languages such as Matlab) to compute numerical solutions. [CEAB Indicator(s): 1.4, 5.1, 5.2, 5.3, 12.1]

6. **POLICIES**

**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. [Link to policy]

**Academic Integrity**

Attention is drawn to the Statement on Academic Ethics and the Senate Resolutions on Academic Dishonesty as found in the Senate Policy Statements distributed at registration and available in the Senate Office. Any student who infringes one of these resolutions will be treated according to the published policy.

Academic dishonesty consists of misrepresentation by deception or by other fraudulent means and 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.

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, specifically Appendix 3, located at: [Link to policy]

**Academic Accommodation of Students with Disabilities Policy**

The Centre for Student Development is committed to the continuous improvement of accessibility for students with disabilities. Students are encouraged to contact CSD as early as possible before each term starts to become familiar with the services offered and to confirm their accommodations.

Students must forward a copy of the CSD 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 CSD accommodation and chooses to sit for a regular exam, a petition for relief may not be filed after the examination is complete. [Link to CSD website]