Carleton University

Department of Systems and Computer Engineering

ECOR 2606 ***Numerical Methods*** ***Winter 2018***

Course Outline

Instructor:

Sections	Instructor	Office	Email
D&E	**Kevin Goheen**	**4230ME**	kgoheen@sce.carleton.ca

Course Description:

Numerical algorithms and tools for engineering and problem solving. Sources of error and error propagation, solution of systems of linear equations, curve fitting, polynomial interpolation and splines, numerical differentiation and integration, root finding, solution of differential equations. Software tools.
Precludes additional credit for SYSC 2606
Prerequisites: MATH 1005 and (ECOR 1606 or SYSC 1005) and (ECOR 1010 or ELEC 1908).

Learning Outcomes:

By the end of this course students should be able to:

1) execute numerical algorithms to solve problems related to: Root finding, Optimization, Linear Systems, Regression, Interpolation, Integration and Differentiation
2) use built-in functions in Matlab to produce numerical results
3) implement basic Matlab programs to solve problems

Instructional Resources:

- Course material will be posted on the cuLearn site
- Recommended Textbook: Either one of the two books listed (both are on reserve in the library):
  - *Applied Numerical Methods with MATLAB: for Engineers and Scientists*; Steven Chapra; McGraw Hill, Third Edition (2011) or Second Edition (2008).
  - *Numerical Methods for Engineers and Scientists; An Introduction with Applications using MATLAB*; Amos Gilat and Vish Subramaniam, John Wiley & Sons, Inc., Third Edition (2014) or Second Edition (2011).
- Students may download a copy of Matlab for their personal use at no charge. Please see the instructions on cuLearn

Grading Scheme:

Element	Dates	Weight
Tutorial Labs	See lab schedule (next page)	5% (1% each, up to a maximum of 5)
Lab Quizzes	See lab schedule (next page)	25% (5% each)
Midterm Exam (75 min)	Feb 28 (during class time)	20%
Final Exam (3 hours)	During the university's exam period	50%

a) In order to pass the course, students must pass the final exam.
b) If a student misses the midterm and valid documentation is provided, they will write a deferred midterm on 9 March 2018 at 0830.
c) Students who miss a lab quiz with valid documentation may write with another section in which there is room. If that is not possible, the weight will be added to the other lab quizzes.
d) **Physicians' notes will only be accepted if they are dated within one day of the test and submitted within three working days.**
e) Problem sets will be assigned. They will not be graded but your understanding of the correct solutions will be important for success in the graded components.

Health and Safety:

Every student should have a copy of our Health and Safety Manuel. An electronic version can be found at: http://www.sce.carleton.ca/courses/health-and-safety.pdf.

Calculators:

Only approved calculators may be used during tests. The list of approved calculators will be posted. Students whose calculators are not on this list may apply to have them added to it. Any such applications must be made **at least five working days prior** to a test. Graphing and programmable calculators will **not** be considered.

Carleton University

Department of Systems and Computer Engineering

ECOR 2606 ***Numerical Methods*** ***Winter 2018***

Course Outline

Lab Schedule:

Lab No		L1 R:1435-1555	L2 F: 1435-1555	L3 R:1135-1255	L4 R:1005-1125	L5 M:1605-1725	L6 F:1135-1255	L7 W:1435-1555	L8 R:1605-1725
1		Jan 18	Jan 19	Jan 18	Jan 18	Jan 15	Jan 19	Jan 17	Jan 18
2		Jan 25	Jan 26	Jan 25	Jan 25	Jan 22	Jan 26	Jan 24	Jan 25
3	Quiz #1	Feb 1	Feb 2	Feb 1	Feb 1	Jan 29	Feb 2	Jan 31	Feb 1
4		Feb 8	Feb 9	Feb 8	Feb 8	Feb 5	Feb 9	Feb 7	Feb 8
5	Quiz #2	Feb 15	Feb 16	Feb 15	Feb 15	Feb 12	Feb 16	Feb 14	Feb 15
6		Mar 1	Mar 2	Mar 1	Mar 1	Feb 26	Mar 2	Feb 28	Mar 1
7	Quiz #3	Mar 8	Mar 9	Mar 8	Mar 8	Mar 5	Mar 9	Mar 7	Mar 8
8		Mar 15	Mar 16	Mar 15	Mar 15	Mar 12	Mar 16	Mar 14	Mar 15
9	Quiz #4	Mar 22	Mar 23	Mar 22	Mar 22	Mar 19	Mar 23	Mar 21	Mar 22
10		Mar 29	Apr 6	Mar 29	Mar 29	Mar 26	Apr 6	Mar 28	Mar 29
11	Quiz #5	Apr 5	Apr 11	Apr 5	Apr 5	Apr 2	Apr 11	Apr 4	Apr 5

Outline:

Topic	Chapra	Gilat/Subramaniam
Introduction	Ch 1	
Root Finding - Matlab: the basics, functions, vectors, plotting, fzero, roots - Theory: Bisection, Regula Falsi, Secant, Newton's Methods	Ch 2, 3, 5, 6	Appendix A, Ch 3
Minimization / Maximization - Matlab: fminbnd - Theory: Golden Section Search	Ch 7	Not covered
Systems of Linear Equations (Direct methods) - Matlab: matrices, left division, inv, lu - Theory: Gaussian, Gaussian with partial pivoting, Gauss-Jordan, Gauss-Thomas elimination, numerical errors, matrix condition, matrix inverse, LU Factorization	Ch 8, 9, 4, 10, 11, 12 (Gauss-Jordan not covered)	Ch 4.1-4.6, 1.2-1.3, 4.8-4.11
Systems of Linear Equations (Iterative methods): - Theory: Gauss-Seidel, Jacobi	Ch 12	Ch 4.7
Regression (Polynomial and General Linear Least Squares) - Matlab: polyfit, polyval, left division, qr - Theory: least squares, QR factorization	Ch 13, 14	Ch 5.1-5.4
Interpolation (Polynomial and Splines) - Matlab: polyfit, interp1, spline, ppval - Theory: Lagrange polynomial, Newton's polynomial, splines	Ch 15, 16	Ch 5.5 - 5.6
Numerical Integration - Matlab: trapz, quad - Theory: trapezoidal integration, Simpson's rules, Richardson extrapolation (Romberg integration), Gaussian quadrature	Ch 17, 18	Ch 7
Numerical Differentiation - Matlab: diff, gradient - Theory: forward, backward, and central difference formulae, Richardson extrapolation	Ch 19	Ch 6
Differential Equations - Matlab: ode45 - Theory: Euler's method, Heun's methods, MISO systems	Ch 20	Ch 8

Course Outline

Academic Obligations:

You may need special arrangements to meet your academic obligations during the term. For an accommodation request the processes are as follows:

- **Pregnancy obligation**: Contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details visit the Equity Services website: http://www.carleton.ca/equity/.

- **Religious obligation**: Contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details visit the Equity Services website: http://www.carleton.ca/equity/.

- **Academic Accommodations for Students with Disabilities:** The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or pmc@carleton.ca for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send your instructor your ***Letter of Accommodation*** at the beginning of the term, **and no later than two weeks before the first in-class scheduled test or exam requiring accommodation**. **Requests made within two weeks will be reviewed on a case-by-case basis.** After requesting accommodation from PMC, meet with your instructor to ensure accommodation arrangements are made. Please consult the PMC website (www.carleton.ca/pmc) for the deadline to request accommodations for the formally-scheduled exam . **Note that PMC will ensure that you are provided with accommodations for the midterm and final exams. <u>If you also wish accommodations for the Lab Quizzes, you must specifically request that.</u>**

You can visit the Equity Services website to view the policies and to obtain more detailed information on academic accommodations at: http://www.carleton.ca/equity/.

Academic Integrity:

Students are requested to review Carleton's Academic Regulations, in particular the policy on Academic Integrity: http://calendar.carleton.ca/undergrad/regulations/academicregulationsoftheuniversity/acadregsuniv14/.

Exam Regulations: All tests, quizzes and exams are governed by Carleton University examination regulations**. https://carleton.ca/ses/examination-regulations/**

Section 2.5 of the Academic Calendar applies to all exams and lab quizzes. Students are expected to complete the midterm examination or lab quiz once begun. If the student experiences a significant deterioration of his/her health while the exam/quiz is in progress, it may be possible to appeal to your instructor.