Carleton University

Department of Systems and Computer Engineering

ECOR 2606 ***Numerical Methods*** ***Fall 2015***

Course Outline

Instructor:

Sections	Instructor	Office	Email
A, B&C	**Lynn Marshall**	**4230ME**	lynnmar@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 SCE web site: http://sce.carleton.ca/courses/ecor-2606/f15/.
- 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 wish to purchase the student version of MATLAB. This could be the best $50 you ever spend! Details at: https://www.mathworks.com/store/link/products/student?s_iid=coabt_sv_abtus_bod.

Grading Scheme:

Element	Dates	Weight
Tutorial Labs	See lab schedule (next page)	5% (1% each)
Lab Quizzes	See lab schedule (next page)	25% (5% each)
Midterm Exam (75 min)	October 20 or 21 (during class time)	**20%**
Final (3 hours)	During the university's exam period	50%

a) In order to pass the course, students must pass the final exam.
b) The final examination is for evaluation purposes only and will not be shown to or returned to students.
c) There will be no alternate scheduled time for the midterm examination. If valid documentation is provided, the weight will be added to the final exam.
d) Students who miss a lab quiz with valid documentation may write with another section. If that is not possible, the weight will be added to the other lab quizzes.
e) Doctors' notes will only be accepted if they are dated within one day of the test and submitted within five working days.
f) 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 **well in advance** of a test. Graphing and programmable calculators will **not** be considered.

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Lab Schedule:

Lab No		L1 R:1005-1125	L2 M:1135-1255	L3 R:1135-1255	L4 F:1135-1255	L5 F:1305-1425	L6 W:1305-1425	L7 W:0835-0955	L8 M:1305-1425
1		Sept 17	Sept 14	Sept 17	Sept 18	Sept 18	Sept 16	Sept 16	Sept 14
2		Sept 24	Sept 21	Sept 24	Sept 25	Sept 25	Sept 23	Sept 23	Sept 21
3	Quiz #1	Oct 1	Sept 28	Oct 1	Oct 2	Oct 2	Sept 30	Sept 30	Sept 28
4		Oct 8	Oct 5	Oct 8	Oct 9	Oct 9	Oct 7	Oct 7	Oct 5
5	Quiz #2	Oct 15	Oct 19	Oct 15	Oct 16	Oct 16	Oct 14	Oct 14	Oct 19
6		Oct 22	Nov 2	Oct 22	Oct 23	Oct 23	Oct 21	Oct 21	Nov 2
7	Quiz #3	Nov 5	Nov 9	Nov 5	Nov 6	Nov 6	Nov 4	Nov 4	Nov 9
8		Nov 12	Nov 16	Nov 12	Nov 13	Nov 13	Nov 11	Nov 11	Nov 16
9	Quiz #4	Nov 19	Nov 23	Nov 19	Nov 20	Nov 20	Nov 18	Nov 18	Nov 23
10		Nov 26	Nov 30	Nov 26	Nov 27	Nov 27	Nov 25	Nov 25	Nov 30
11	Quiz #5	Dec 3	Dec 7	Dec 3	Dec 4	Dec 4	Dec 2	Dec 2	Dec 7

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 - 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, midpoint method	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. After requesting accommodation from PMC, meet with your instructor to ensure accommodation arrangements are made. Please consult the PMC website for the deadline to request accommodations for the formally-scheduled exam at: http://www.carleton.ca/pmc/students/dates-and-deadlines/. **Note that we will ensure that you are provided with accommodations for the midterm and final exams. If you also wish accommodations for the Lab Quizzes, you must specifically request that.**

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/.