

WESTERN UNIVERSITY
DEPARTMENT OF APPLIED MATHEMATICS
Graduate Course Outline Fall 2016
AM9561A: Graduate Introduction to Numerical Methods

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COURSE DESCRIPTION

Every engineer and scientist needs to know how to solve mathematical problems numerically. This course gives a coherent explanation of how to do so, and how to know when the answer is correct: if you do it right, the computer will give you the exact answer to a nearby problem. Some problems are sensitive (aka “ill-conditioned”) and this course teaches that, too. We use MATLAB and a little MAPLE. No prior programming experience is assumed, but will be helpful if you have it.

TEXT

- *Graduate Introduction to Numerical Methods* by Corless & Fillion; pdf copy (free, not for distribution) and soft-cover copy (USD\$24.99) through library subscription:
<http://link.springer.com/book/10.1007%2F978-1-4614-8453-0>
(NB: the above hyperlink in the pdf file works for off-campus access, whereas the link text only works on campus networks)

This book was listed as the ACM “Best of 2013” when it was published. A review by Nick Higham (Manchester) can be found here: (click link). A review by Alex Townsend (Cornell) will appear in SIAM Review. The book was written at Western, and many drafts were polished with the help of Engineering and Science Graduate students, since about 2010.

OPTIONAL TEXTS

MATLAB

- *Matlab Guide* by D. J. Higham & N. J. Higham, 2005, SIAM. Pre-publication, June 27 2000 version, not for distribution available from google search.
- *Numerical Computing with MATLAB* by Cleve Moler; available free for individual use:
www.mathworks.com/moler/chapters.html
- *The Elements of MATLAB Style* by Richard K. Johnson, 2011, CUP.
- *Learning MATLAB*, Tobin A. Driscoll, 2009, SIAM.

THEORY

- *The Concept of Stability in Numerical Mathematics* by Wolfgang Hackbusch, 2014, Springer.
- *Approximation Theory, Approximation Practice* by Nick Trefethen, 2013, SIAM; (MATLAB source code available at <https://people.maths.ox.ac.uk/trefethen/ATAP/>)

METHODS OF EVALUATION

Reading memos:	5%
Assignments:	50%
Midterm:	20%
Final Exam:	25%

Medical & Non-Medical Absences: If a student has received academic accommodation, missed components will be given a pro-rated equivalent mark based on their other work, the class average, and their average. For work amounting to 10% or less, the instructor will make the accommodation.

Electronic Devices on Exams: The midterm will be closed book, closed notes (a formula sheet will be provided) and no calculators or computers will be permitted. The final exam will take place in a lab, and each student will be given access to MATLAB but not email or the Web. No other devices may be used.

IMPORTANT DATES:

- Midterm: Oct 25, 2 hour in-class
- Assignments Due at 11:59:59 pm on
 - Assignment 0: End of First Lab
 - Assignment 1: Sep 22
 - Assignment 2: Oct 13
 - Assignment 3: Nov 10
 - Assignment 4: Dec 1

The final exam will be computer-based and require proficiency in MATLAB.

MATERIALS COVERED

- Selected topics (not necessarily in this order) from:
 - Appendix:
 - * A: Floating-Point Arithmetic

- Chapters:
 - * 1: Computer Arithmetic and Fundamental Concepts of Computation
 - * 2: Polynomials and Series
 - * 3: Rootfinding and Function Evaluation
 - * 4: Solving $Ax = b$
 - * 5: Solving $Ax = \lambda x$
 - * 8: Polynomial and Rational Interpolation
 - * 9: The Discrete Fourier Transform
 - * 10: Numerical Integration
 - * 11: Numerical Differentiation and Finite Differences
 - * 12: Numerical Solution of ODEs
- Depending on class interests, one of Chapters:
 - * 14: Numerical Solutions of Boundary Value Problems
 - * 15: Numerical Solution of Delay DEs
 - * 16: Numerical Solution of PDEs
- Selected readings from the other chapters.
- The course will meet 3 hours per week for lectures and once per week in a computer lab.
- Assignments are challenging, but consultation with your peers is allowed—even encouraged—provided such consultation is acknowledged. Collaboration is also encouraged, though it is expected that your assignments are written entirely by you. Explicit permission may be given for certain assignments for team-produced code.

ADDENDUM TO ALL APPLIED MATHEMATICS COURSE OUTLINES

Responsibility for Checking Prerequisites: Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites..

Statement on Academic Offences: Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site:

https://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_grad.pdf.

Use of Plagiarism Checking Software: All required papers may be subject to submission for textual similarity review to the commercial plagiarism detection software under license to the University for the detection of plagiarism. All papers submitted for such checking will

be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between The University of Western Ontario and Turnitin.com (<http://www.turnitin.com>).

Use of Cheating-Analysis Software: Computer-marked multiple-choice tests and/or exams may be subject to submission for similarity review by software that will check for unusual coincidences in answer patterns that may indicate cheating..

Policy on Accommodation for Illness: For access to the University's policy see the following document (which includes a link to the Student Medical Certificate):

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_illness.pdf

Statement of Services for Students in Emotional/Mental Health Distress: Students who are in emotional/mental distress should refer to Mental Health@Western (<http://www.uwo.ca/uwocom/mentalhealth/>) for a complete list of options about how to obtain help.

Accessibility Statement: Please contact the course instructor if you require material in an alternate format or if you require any other arrangements to make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 x 82147 for any specific question regarding an accommodation.