

MATH 2130 - Numerical Methods

Winter 2018

Department of Mathematics & Statistics
University of Guelph

Calendar Description

This course provides a theoretical and practical introduction to numerical methods for approximating the solution(s) of linear and nonlinear problems in the applied sciences. The topics covered include: solution of a single nonlinear equation; polynomial interpolation; numerical differentiation and integration; solution of initial value and boundary value problems; and the solution of systems of linear and nonlinear algebraic equations.

Course Weight: 0.50

Class Schedule and Location: TTh 16:00-17:20 in ROZH 104

Instructor: Prof. Allan Willms

Email: AWillms@uoguelph.ca

Office Location: MACN 512

Office Hours: Tues. 10:30-11:20; Wed. 14:00-16:00; or by appointment

Lab TAs: Maxwell Fitzsimmons, Harry Gaebler, Connor Gregor, Thulasi Jegatheesan, I. Thomas Kielstra, Yousef Rohanizadegan **Other TAs:** Alvaro Balkowski, Valerie Hodgins, Ryan Wilkins

Learning Outcomes

- Learn basic concepts of numerical analysis
- Learn the MATLAB language and how to use MATLAB to solve numerical problems
- Become familiar with a number of basic numerical algorithms for various classes of problems
- Be able to code simple numerical algorithms in the MATLAB language

Lecture Content

- Introduction to MATLAB.
- Computational basics: algorithms, error, convergence.
- Finding roots of functions of one variable via: bisection, secant-type methods, Newton's method, Muller's method.
- Minimizing functions of one variable via: Golden-Section search and Brent's method.
- Gaussian elimination for solving systems of linear equations.
- Jacobi and Gauss-Seidel iterative methods for solving systems of linear equations.
- Solving nonlinear systems of several variables via: Newton's method, secant methods, fixed-point iteration.
- Minimizing functions of several variables via: descent methods, quasi-Newton methods.
- Interpolation via: polynomials, Hermite interpolation, piece-wise methods such as cubic splines, etc.
- Numerical differentiation.
- Numerical integration via: Trapezoid rule, Simpson's rule, Newton-Cotes formulas.
- Introduction to numerical solutions of ordinary differential equations via: Euler's method, Runge-Kutta methods, multistep methods.

Evaluation

| Assessment | date/time | place | weight |
|-----------------|---------------------------------|-----------|--------|
| Lab Work | weekly as per your lab schedule | THRN 1319 | 10% |
| Midterm Test I | Thurs. Feb. 15 16:00-17:20 | ROZH 104 | 20% |
| Midterm Test II | Thurs. Mar. 29 16:00-17:20 | ROZH 104 | 20% |
| Final Exam | Fri. Apr. 13, 8:30 - 10:30 | TBD | 50% |

Texts

Required:

- *Applied Numerical Analysis Using MATLAB (Custom Edition for University of Guelph) Laurene V. Fausett, Pearson Education, 2008.*

This text has selected chapters from Fausett's text *Applied Numerical Analysis Using MATLAB*. We will cover most of the material in the selected chapters.

A copy of the full text has been placed on reserve in the library.

Computer Labs

There are weekly computer labs. During these lab sessions you will be given questions to work on using MATLAB. Some of these questions will be from the text book, so you should bring your copy to the labs. The lab instructors will provide instruction and individual assistance as necessary. At least four times in the semester your name will be randomly selected and your lab work will be assessed in the lab by a lab instructor. These four assessments will constitute your lab mark worth 10% of your grade. It is therefore imperative that you attend the lab section in which you are enrolled.

Grading Policy

The midterm tests will be in class and therefore you are expected to write them. No alternate test times will be given. Accommodation due to illness etc. will be given according to university policy. Midterm tests will be marked as quickly as possible and returned via CrowdMark. Marks will be available on CourseLink. It is the student's responsibility to check that the posted marks are accurate. All requests for reassessment of assignments and/or the midterm test **must** follow the [procedures](#) outlined on the course web page.

University Policies

E-mail Communication

All students are required to check their University of Guelph e-mail account regularly; e-mail is the official route of communication between the University and its students.

Academic Accommodation of Religious Obligations

If you are unable to complete a course requirement due to religious obligations, please let the instructor know within the first two weeks of class. See the academic calendar for more information:

<http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-accomrelig.shtml>

Academic Consideration

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons, please advise the course instructor in writing, with your name, id, and e-mail contact. See the academic calendar for information on regulations and procedures for Academic Consideration:

<http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml>

Academic Misconduct

The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community, faculty, staff, and students to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff and students have the responsibility of supporting an environment that discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection. Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor. The Academic Misconduct Policy is detailed in the Undergraduate Calendar:

<http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml>

Accessibility

The University of Guelph is committed to creating a barrier-free environment. Providing services for students is a shared responsibility among students, faculty and administrators. This relationship is based on respect of individual rights, the dignity of the individual and the University community's shared commitment to an open and supportive learning environment. Students requiring service or accommodation, whether due to an identified, ongoing disability or a short-term disability should contact the Student Accessibilities Services (SAS) as soon as possible. For more information, contact SAS at 519-824-4120 ext. 56208 or email csd@uoguelph.ca or see the website: <http://www.uoguelph.ca/csd/>

Drop date

The last date to drop one-semester courses, without academic penalty, is the 40th day of classes, Friday, March 9, 2018. See the Undergraduate Calendar Schedule of Dates:

<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c03/index.shtml>

For regulations and procedures for Dropping Courses, see the Academic Calendar:

<http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml>

Recording of Materials

Presentations which are made in relation to course work, including lectures, cannot be recorded in any electronic media without the permission of the presenter, whether the instructor, a student, or guest lecturer. When recordings are permitted they are solely for the use of the authorized student and may not be reproduced, or transmitted to others, without the express written consent of the presenter.