

MATH 2130 - Numerical Methods

Winter 2019

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: MWF 12:30-13:20 in WMEM 103

Lab Location: THRN 1319

Instructor: Prof. Allan Willms

Email: AWillms@uoguelph.ca

Office Location: MACN 512

Office Hours: MWF 14:00-15:00 or by appointment

Lab TAs:

Section 01 Thur. 10:30 TBA

Section 02 Mon. 11:30 TBA

Section 03 Thur. 8:30 TBA

Section 04 Wed. 8:30 TBA

Section 05 Mon. 8:30 TBA

Section 06 Tues. 8:30 TBA

Section 07 Tues. 1:30 TBA

Section 08 Wed. 11:30 TBA

TA Email addresses:

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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	6%
Midterm Test I	Wed. Jan. 30 12:30-13:20	WMEM 103	18%
Midterm Test II	Wed. Feb. 27 12:30-13:20	WMEM 103	18%
Midterm Test III	Wed. Mar. 27 12:30-13:20	WMEM 103	18%
Final Exam	Mon. Apr. 22, 19:00 - 21:00	TBD	40%

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. These begin in the *first* week of classes. 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 some group instruction at the beginning, and individual assistance as necessary. Each week you will be required to submit your answers to a small portion of the lab work. This submission will be marked out of 4; your best 9 marks of the 12 labs will be used to generate your lab grade. If you wish to do reasonably well in the course, you **MUST** attend the lab sessions.

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 8, 2019. 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.