IAM 550

INTRODUCTION TO ENGINEERING COMPUTING

Version of 08/25/2019

Fall Semester 2019
Lecture: Tuesdays and Thursdays, 2:10pm-3:30pm, Parsons N108
Laboratory: T/TH, 8:10-9:00 and 10:10-11:00 (4 sections, you only go to one), Kingsbury W 114
Labs start September 3!

Co-requisite: MATH 426 (Calculus II)

Instructor:

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Office hours: Tuesdays 11-12

Course Description:

This course is an application-driven introduction to computer-aided problem solving leveraging foundational knowledge in engineering and the physical sciences. Physics and Engineering applications will be used to motivate the computational methods needed in scientific and engineering disciplines. Numerical methods, including the basic LU algorithm, one-dimensional root finding methods, and numerical differentiation and integration, will be introduced as useful computational tools for tackling a broad range of engineering and scientific applications and to provide concrete and contextual programming experiences. MATLAB will be used, with topics including scripts, functions, arrays, logical expressions, conditional statements, looping, data visualization, plotting, input/output, and recursion presented within the framework provided by both the numerical methods and the scientific or engineering problems.

A primary course aim is to provide students with a firm grounding in computational problem-solving in engineering and the physical sciences by introducing computational methods through a range of problems drawn from these disciplines. The numerical content we will explore during the semester includes, not necessarily in this order:

- Computer basics and languages
- Representation of numbers and associated errors
- Evaluation of functions and Taylor series
- Sorting and searching data sets
- Numerical differentiation
- Numerical integration
- Root finding algorithms
- Numerical solutions of linear algebraic equations
- Interpolation and curve fitting

- Random numbers
- Statistical data analysis
- If time permits: Fourier series and power spectra

The numerical content will be actively employed by students using the MATLAB programming language. No prior knowledge of MATLAB is required. The MATLAB programming content is integrated with the numerical content throughout the course. By the end of the course, students are expected to be proficient in MATLAB programming basics including scripting, functions, variables and arrays, input/output commands, logical expressions and Boolean operations, if/then/else statements, for and while loops, graphics and plotting, and recursion. While MATLAB will be used throughout the course, concepts will be presented in a manner which will allow them to be readily extended to other computational environments. The syntax of other common languages such as Perl, C, and Fortran will be briefly addressed.

Students who actively participate in the course will develop the algorithmic thinking skills needed to write MATLAB programs to numerically solve complex problems that span a breadth of mechanical engineering sub-disciplines. The topics covered are designed to strengthen and expand the students mathematical and engineering skills, and to prepare them for concurrent and future study in the areas of fluid and thermal science, mechanics, materials science, design and manufacturing, dynamic systems and control, and ocean engineering. This course also serves as a gateway to more advanced courses on numerical methods or computer programming.

Course Organization:

The course will consist of two lectures and one laboratory session per week over the duration of semester. Students will be responsible for completing laboratory and homework problems, and taking one midterm and one final examination. Exams may be given as take-home exams.

The lectures will include computer demonstrations. Students are encouraged to bring their laptops to follow the instructor's examples. However, laptops must remain closed until the instructor allows them to be opened and be closed again when so instructed. Furthermore, students must turn off wifi while in class. Alternatively, notes should be taken.

Required Text: None.

MATLAB is sufficiently documented on the Web and through the help system in the MATLAB software.

The numerical algorithms that are discussed in the lecture are very basic. Any text on numerical methods or the great book of Google can provide backup, but taking notes in class is preferred for pedagogical reasons.

Course notes and other supplementary materials will be used extensively throughout the semester. This material will be posted to the course page (mycourses.unh.edu).

Texts on MATLAB, in no particular order:

- *Introduction to MATLAB for Engineers*, 4rd Ed., W. J. Palm, McGraw-Hill, ISBN: 978-1-259-40538-9 (was used in some previous IAM550 classes).
- *Applied Numerical Methods with MATLAB for Engineers and Scientists*, S. Chapra, McGraw-Hill, ISBN 0:072392657
- *Mastering MATLAB 7*, D Hanselman, B. Littlefield, Pearson Prentice Hall, ISBN 0-13-143015-1
- Applied Numerical Methods for Engineers Using MATLAB and C, R. Schilling, S. Harris, Brooks-Cole, ISBN 0534370144
- *Numerical Methods in Engineering with MATLAB*, J. Kiusalaas, Cambridge University Press, ISBN-10: 0521852889
- *Engineering Computation with MATLAB*, D. M. Smith, Addison-Wesley, ISBN10-10:0135080634

Texts on numerical methods:

- *Numerical Methods for Scientists and Engineers*, 2. Edition, R. W. Hamming, Dover Publications, ISBN-13: 978-0-486-65241-2 (cheap, old, but still relevant)
- *Numerical Recipes, The Art of Scientific Computing*, W. H. Press et al., various editions. (This book is an excellent text and reference that should be on the shelf of everyone who does some serious scientific computing. Contains a lot of example code in either Fortran or C. It appears that there are pdf versions for download on the Internet, but there may be copyright issues.)
- *Numerical Methods for Engineers*, D.V. Griffiths and I.M. Smith, CRC Press, ISBN-9781584884019

Grading:

Homework: 10%
Computer Lab: 50%
Midterm Examination: 20%
Final Examination: 20%

Computer Lab:

Computer laboratory sessions will be held weekly, with a few exceptions. The labs are intended to build student's MATLAB programming capabilities and to supplement the material covered in the lectures. Lab attendance is mandatory and will count for 25% of the computer lab grade; laboratory reports will count for the remaining 75% of the computer lab grade.

While some computer labs can be completed during the laboratory session, it is generally expected that students will complete lab assignments out of class.

Late laboratory reports will not be accepted without prior agreement (in writing, or in an email) from Prof. Raeder and a valid reason, and will receive zero credit.

Homework:

Homework is due at the beginning of class one week after it is assigned. Late homework will not be accepted without prior agreement (in writing, or in an email) from Prof. Raeder and a valid reason, and will receive zero credit. Partial credit will be given as long as the solution follows/explains a coherent thought process. Simply writing down an answer without justification is not acceptable. Homework grading will be done according with a detailed score card. The score card will be available to the students, so that the expectations are clear.

Any grading disputes must first be addressed with the TA grader, who will make an attempt to resolve the issue. Only if this remains fruitless, the issue should be brought up with the instructor.

Exams:

There is one midterm examination and one final examination. Normally, no make-up exams will be given; as a courtesy, extenuating circumstances will be considered.

Web-based course management:

myCourses/canvas (https://mycourses.unh.edu) will be open for this class, but not used very much, because it lists each section as a separate class, which is very inconvenient for all class wide material. Thus, mycourses will primarily be used for grades only. All other materials will be published on http://squirrel.sr.unh.edu/~jraeder/IAM550/index.html. Students should check into this site before each class. Class scripts and other materials will be posted by noon on the day before class. Also, students' email addresses will be collected and announcements will be emailed directly.

Classroom-Behavior Expectations

Students are expected to fully participate in classroom lectures. Questions, discussion, and other comments on the academic material of the course are encouraged and help enhance the lectures.

To insure a climate of learning for all, disruptive or inappropriate behavior (repeated outbursts, disrespect for the ideas of others, etc.) may result in exclusion (removal) from this class. As a reminder, cell phone/pda, etc. use, including text messaging, is not permitted in this class by Faculty Senate rule unless by instructor permission.

Academic Honesty:

Ethical behavior is essential for the engineering professionals due to the nature of the work and is expected during your academic training as well. You are required to comply with all University policies regarding Academic Honesty and to familiarize yourself with those policies (www.unh.edu/vpsas/handbook/academic-honesty). Suspected violations of academic honesty are handled following Section 9.7, Procedures for Dealing with Academic Misconduct in the Student Rights, Rules, and Responsibilities Handbook, and may result in failure of an assignment, a failing grade in the course, probation, suspension, or expulsion.

Collaborating on homework and laboratory assignments (but *not* exams) is acceptable and encouraged in this course only to the extent that it supports peer-to-peer learning. This means that you are welcome to discuss the assignments conceptually, to help one another understand numerical algorithms, and to help one another become better MATLAB programmers. HOWEVER, you should refrain from looking at the final solution that a classmate will hand in for their assignment, and your assignments (including MATLAB code, laboratory reports, and any other works) must be written by you alone.

Disabilities:

The University is committed to providing students with documented disabilities equal access to all university programs and facilities. If you think you have a disability requiring accommodations, you must register with Disability Services for Students (DSS). If you have received an accommodation letter for this class, please contact me immediately so we can discuss the necessary arrangements. Contact DSS at
www.unh.edu/disabilityservices/clockwork, (603) 862-2607 or disability.office@unh.edu.

Emotional or Mental Health Distress

Your academic success in this course is very important to me. If, during the semester, you find emotional or mental health issues are affecting that success, please contact the University's Counseling Center (3rd floor, Smith Hall; 603 862-2090/TTY: 7-1-1), which provides counseling appointments and other mental health services.