MA 346 Numerical Methods

School of Engineering and Science
Spring 2022

Live Sessions: Tuesdays/Thursdays 5:00-6:15 pm ET
Classroom Location: Morton 205
Instructor: Dr. Kathrin Smetana
Contact Info: ksmetana@stevens.edu
Office Hours: Tuesdays and Thursdays, 6:20-7:20 pm ET
Canvas Course Web Address: https://sit.instructure.com/courses/58042
Prerequisite(s): Calculus of Two Variables
Corequisite(s): None
Cross-listed with: None
Credits: 3

COURSE DESCRIPTION

Students are taught fundamental principles regarding machine representation of numbers, types of errors, and propagation of errors. The numerical methods include finding zeros of functions, solving systems of linear equations, interpolation of functions, numerical integration and differentiation, and solving initial value problems of ordinary differential equations.

STUDENT LEARNING OUTCOMES

After successful completion of this course, students will be able to…

- **Compare** algorithms based on their requirements, key concepts, convergence behavior, and computational complexity.
- **Determine** which algorithms are suited in which situations.
- **Analyze** the stability of algorithms.
- **Analyze** the convergence of certain algorithms.
- **Implement** the algorithms discussed in the course.
- **Solve** linear systems of equations.
- **Determine** numerically the root of nonlinear functions.
- **Solve** ordinary differential equations (numerically).

Instructor's Online Hours

I will be available via email and will respond as soon as I am available (generally within 24-48 hours). For the online discussions, I will check in at least 3 times per week. Keep in mind that it is not possible for me to respond to every single posting every week (nor is it pedagogically appropriate), but I will be sure to respond to a variety of postings and students each week and attempt to assure equality in terms of responses to students. Furthermore, there is a specific discussion forum that you can use to ensure that you have my attention – to ask questions or to call my attention to a particular discussion you are engaged in that you would like me to take a look at. If you feel you are being neglected in any way, please contact me. When emailing me, please place in the subject line the course number/section and the topic of the email (i.e. MA346– Written Homework 2 Question).

TENTATIVE COURSE SCHEDULE

Changes to the below schedule, if there are any, will be posted via Canvas Announcement.

Written Homework is due by 11:59pm ET on the Sunday of the assigned week, unless specified otherwise by your instructor.

Course Schedule (14 weeks)

Module	Topic(s)	Readings	Assignment
Week 1	Introduction and Course Overview; Review of Calculus; Various sources of errors; Computer Arithmetic	1.1, 1.2	Matlab Tutorial
Week 2	Algorithms, Convergence and Stability; Linear Systems of Equations	1.3, 6.1	Homework 1
Week 3	Pivoting; Linear algebra and matrix inversion	6.2, 6.3	Homework 2
Week 4	Determinant; Matrix factorization; Special matrices	6.4-6.6	Homework 3
Week 5	Bisection method; fixed point iteration; Newton's method	2.1-2.3	Homework 4 (Implementation)
Week 6 (February 22 follows a Monday class schedule)	Error analysis for iterative methods; accelerating convergence	2.4, 2.5	Homework 4

Week 7	Interpolation and the Lagrange polynomial	3.1	
Week 8			Midterm Exam
Week 9	Spring Break		
Week 10	Data approximation and Neville's method; Divided differences; Hermite interpolation;	3.2-3.4	
Week 11	Spline interpolation; Numerical differentiation; Richardson's extrapolation	3.5, 4.1, 4.2	Homework 5
Week 12	Elements of numerical integration; Composite numerical integration, Romberg	4.3-4.5	Homework 5
Week 13	Quadrature methods; Gaussian quadrature; multiple integrals	4.6-4.8	Homework 6
Week 14	Initial-value problems; Euler method;	Slides; Book: 5.1, 5.2, 5.4, 5.5.	Homework 7
Week 15	Runge Kutta methods; Analysis of One-Step Methods	Slides	Homework 8
Week 16 (May 4 is last day of classes)	Review	None	Final Exam

COURSE MATERIALS

Textbook:

Richard L. Burden, J. Douglas Faires: *Numerical Analysis*, 9th Ed, Cengage Learning, 2011.

Additional Reading:

Supplementary reading materials will be provided throughout the course.

GRADING PROCEDURES

Grades will be based on:

Homework	30%
Midterm	20%
Final	40%
Live Session Participation	10%

Grading Scale

The conversion of numerical grades (0-100) to Final Letter Grades (A-F) will be made according to the following scale

A	[90,100]	A-	[86, 90)	
B+	[82,86)	B	[78,82)	B- [74,78)
C+	[70,74)	C	[64,70)	C- [60,64)
D	[50,60)	F	[0,50)	

Live Session Participation

Key content of the week's material is highlighted, and students work in groups on smaller problems. In addition, groups of students will present their solutions to the homework (graded activity). Attendance is mandatory.

Policy with respect to Written Homework

Out of the 9 Homeworks (8 theoretical Homeworks + 1 Implementation Homework) the two Homeworks with the worst grades will automatically be dropped.

Late Policy

You are allowed to take a 7-day extension on the Homework Assignment once in the entire course, excluding Homework 9. To request this extension, please contact the instructor. Submissions that are late otherwise will not be accepted.

Academic Integrity

Undergraduate Honor System

Enrollment into the undergraduate class of Stevens Institute of Technology signifies a student's commitment to the Honor System. Accordingly, the provisions of the Stevens Honor System apply to all undergraduate students in coursework and Honor Board proceedings. It is the responsibility of each student to become acquainted with and to uphold the ideals set forth in the Honor System Constitution. More information about the Honor System including the constitution, bylaws, investigative procedures, and the penalty matrix can be found online at http://web.stevens.edu/honor/

The following pledge shall be written in full and signed by every student on all submitted work (including, but not limited to, homework, projects, lab reports, code, quizzes and exams) that is assigned by the course instructor. No work shall be graded unless the pledge is written in full and signed.

"I pledge my honor that I have abided by the Stevens Honor System."

Reporting Honor System Violations

Students who believe a violation of the Honor System has been committed should report it within ten business days of the suspected violation. Students have the option to remain anonymous and can report violations online at www.stevens.edu/honor.

EXAM CONDITIONS

The precise dates and times and exam conditions of the midterm and final examination will be announced via Canvas.

LEARNING ACCOMMODATIONS

Stevens Institute of Technology is dedicated to providing appropriate accommodations to students with documented disabilities. The Office of Disability Services (ODS) works with undergraduate and graduate students with learning disabilities, attention deficit-hyperactivity disorders, physical disabilities, sensory impairments, psychiatric disorders, and other such disabilities in order to help students achieve their academic and personal potential. They facilitate equal access to the educational programs and opportunities offered at Stevens and coordinate reasonable accommodations for eligible students. These services are designed to encourage independence and self-advocacy with support from the ODS staff. The ODS staff will facilitate the provision of accommodations on a case-by-case basis.

For more information about Disability Services and the process to receive accommodations, visit https://www.stevens.edu/office-disability-services. If you have any questions please contact: Phillip Gehman, the Director of Disability Services Coordinator at Stevens Institute of Technology at pgehman@stevens.edu or by phone 201-216-3748.

Disability Services Confidentiality Policy

Student Disability Files are kept separate from academic files and are stored in a secure location within the Office of Disability Services. The Family Educational Rights Privacy Act (FERPA, 20 U.S.C. 1232g; 34CFR, Part 99) regulates disclosure of disability documentation and records maintained by Stevens Disability Services. According to this act, prior written consent by the

student is required before our Disability Services office may release disability documentation or records to anyone. An exception is made in unusual circumstances, such as the case of health and safety emergencies.

INCLUSIVITY

Name and Pronoun Usage

As this course includes group work and class discussion, it is vitally important for us to create an educational environment of inclusion and mutual respect. This includes the ability for all students to have their chosen gender pronoun(s) and chosen name affirmed. If the class roster does not align with your name and/or pronouns, please inform the instructor of the necessary changes.

Inclusion Statement

Stevens Institute of Technology believes that diversity and inclusiveness are essential to excellence in academic discourse and innovation. In this class, the perspective of people of all races, ethnicities, gender expressions and gender identities, religions, sexual orientations, disabilities, socioeconomic backgrounds, and nationalities will be respected and viewed as a resource and benefit throughout the semester. Suggestions to further diversify class materials and assignments are encouraged. If any course meetings conflict with your religious events, please do not hesitate to reach out to your instructor to make alternative arrangements.

You are expected to treat your instructor and all other participants in the course with courtesy and respect. Disrespectful conduct and harassing statements will not be tolerated and may result in disciplinary actions.

MENTAL HEALTH RESOURCES

Part of being successful in the classroom involves a focus on your whole self, including your mental health. While you are at Stevens, there are many resources to promote and support mental health. The Office of Counseling and Psychological Services (CAPS) offers free and confidential services to all enrolled students who are struggling to cope with personal issues (e.g., difficulty adjusting to college or trouble managing stress) or psychological difficulties (e.g., anxiety and depression). Appointments are can be made by phone (201-216-5177).

EMERGENCY INFORMATION

In the event of an urgent or emergent concern about the safety of yourself or someone else in the Stevens community, please immediately call the Stevens Campus Police at 201-216-5105 or on their emergency line at 201-216-3911. These phone lines are staffed 24/7, year round. For students who do not reside near the campus and require emergency support, please contact your local emergency response providers at 911 or via your local police precinct. Other 24/7 national resources for students dealing with mental health crises include the National Suicide Prevention Lifeline (1-800-273-8255) and the Crisis Text Line (text “Home” to 741-741). If you are concerned about the wellbeing of another Stevens student, and the matter is *not* urgent or time sensitive, please email the CARE Team at care@stevens.edu. A member of the CARE Team will respond to your concern as soon as possible.