

Numerical Analysis I MAT 325-01, Spring 2023

MWF 12:00 PM -12:50 PM

Class Meeting: UNA 125

Professor: Dr. Cheng Peng

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Office: UAN 107

Office Hours: Monday/Wednesday: 11:00 AM -11:50 AM, MW 2:00 PM -3:00 PM

Friday: 10:55 AM -11:55 AM

Course Webpage: <https://pengdsci.github.io/MAT325/>. I will post all course materials and related information on this course web page. You are expected to check this web page regularly.

Textbook (required): *Numerical Analysis*, 9th edition, Richard L. Burden and J. Douglas Faires, Brooks/Cole Publishing Company, Pacific Grove, California 2010, ISBN: 978-0538733519.

Course Description: This one-semester course introduces basic concepts in numerical analysis and prepares students for the sequence course in numerical analysis II (MAT 425). In this course, basic numerical algorithms for the solutions to a variety of problems arising in science and engineering will be presented and analyzed. The goal is to study algorithms that converge to the true solutions in a reasonable amount of time, as well as the associated theories in accuracy and stability analysis.

Prerequisites: C or better in MAT 162.

Course Objectives: The main objectives of the course include but are not limited to

- Applying computer arithmetics in developing computer programs for numerical algorithms.
- Assessing methods for numerical solutions of nonlinear scalar equations.
- Identifying effective direct methods of numerical linear algebra.
- Carrying out simple function approximation and interpolation.
- Implementing and improving various algorithms for numerical differentiation and integration.

Learning Outcomes: After completion of the course students are expected to:

- Use error and asymptotic order of convergence to assess numerical methods
- Implement approximation methods (Bisection, Newton, Secant, etc.) for finding the solution of nonlinear algebraic equations.
- Apply direct methods to solve linear systems of algebraic equations.
- Use Lagrange and Newton interpolation to approximate functions.
- Utilize finite differences to approximate derivatives of functions.
- Apply fundamental numerical integration methods (Trapezoidal rule, Simpsons and midpoint rules, etc.).
- Design numerical algorithms and implement them using high-level programming languages.

Attendance and participation: Attendance is crucial to success in this course. It is mandatory to attend every lecture. You are required to actively participate in all class activities.

Class Cancellation: If I am unable to meet a class, I will notify you in the class ahead of time or send you an email notification through the WCU email account.

Email and D2L: You are expected to access D2L and check your WCU email account frequently during the semester. I will make important announcements by sending emails to the class through WCU. You can also access the course web page through D2L.

Homework & Computer Labs: Homework and computer labs will be assigned every week. You are encouraged to collaborate with your classmates on these assignments. However, you are required to write up your work by yourself.

Final Project: There will be a final project focusing on implementing one or more numerical methods/techniques covered during the semester. More details will be provided after the second midterm exam.

Exams: There will be **two** in-class exams. These exams are designed to assess your mastery of the material in the most recently covered chapter(s) of the text. If you are under certain circumstances that prevent you from taking the exams, please schedule a makeup exam with me in advance.

Evaluation:

Homework	25%
Computer Labs	15%
Attendance and participation	10%
Midterms	30% (15% each)
Final Project	20% (10% code + 10% report)
Total	100%

Grading Scale:

%	93-100	90-92	87-89	83-86	80-82	77-79
Letter	A	A-	B+	B	B-	C+
%	73-76	70-72	67-69	63-66	60-62	0-59
Letter	C	C-	D+	D	D-	F

I reserve the right to adjust this scale to improve grades if the course material proves to be unreasonably demanding.

Tentative Schedule

Week	Chapter	Section
1	1	§1.0 Introduction to Numerical Analysis §1.1 Review of Calculus
2		§1.2 Round-off Errors and Computer Arithmetic §1.3 Algorithms and Convergence Computer Lab 1 is due on Friday 2/3
3	2	Homework for Chapter 1 is due on Monday 2/6 §2.1 The Bisection Method §2.2 Fix-Point Iteration Computer Lab 2 is due on Friday 2/10
4		§2.2 Fix-Point Iteration (cont'd) §2.3 Newton's Method and Its Extensions Computer Lab 3 is due on Friday 2/17
5	3	Homework for Chapter 2 is due on Monday 2/20 §3.1 Interpolating & the Lagrange Polynomials §3.3 Divided Differences Computer Lab 4 is due on Friday 2/24
6		§3.3 Divided Differences (cont'd) §3.5 Cubic Spline Interpolation Computer Lab 5 is due on Friday 3/3
7		Homework for Chapter 3 is due on Monday 3/6 §3.6 Parametric Curves Midterm 1 (Fri 3/10, covers Chapters 1-3)
		Spring break (3/13 – 3/19)
8	4	§4.1 Numerical Differentiation §4.3 Elements of Numerical Integration Computer Lab 6 is due on Friday 3/24
9		§4.4 Composite Numerical Integration §4.7 Gaussian Quadrature Computer Lab 7 is due on Friday 3/31
10	5	Homework set 4 is due on Monday 4/3 §5.1 Elementary Theory of IVPs §5.2 Euler's Method Computer Lab 8 is due on Friday 4/7
11		Homework for Chapters 4-5 is due on Monday 4/10 Midterm 2 (Fri 4/14, covers Chapters 4-5)
12	6	§6.1 Linear System of Equations §6.2 Pivoting Strategies
13		§6.3 Linear Algebra and Matrix Inversion §6.4 The Determinant of a Matrix
14		Homework for Chapter 6 is due on Monday 5/1 §6.5 Matrix Factorization
15		The final Project is due on Wed 5/10

ACADEMIC & PERSONAL INTEGRITY

It is the responsibility of each student to adhere to the university's standards for academic integrity. Violations of academic integrity include any act that violates the rights of another student in academic work, that involves misrepresentation of your own work, or that disrupts the instruction of the course. Other violations include (but are not limited to): cheating on assignments or examinations; plagiarizing, which means copying any part of another's work and/or using ideas of another and presenting them as one's own without giving proper credit to the source; selling, purchasing, or exchanging of term papers; falsifying of information; and using your own work from one class to fulfill the assignment for another class without significant modification. Proof of academic misconduct can result in the automatic failure and removal from this course. For questions regarding Academic Integrity, the No-Grade Policy, Sexual Harassment, or the Student Code of Conduct, students are encouraged to refer to the Department Undergraduate Handbook, the Undergraduate Catalog, the Ram's Eye View, and the University website at www.wcupa.edu.

STUDENTS WITH DISABILITIES

If you have a disability that requires accommodations under the Americans with Disabilities Act (ADA), please present your letter of accommodations and meet with me as soon as possible so that I can support your success in an informed manner. Accommodations cannot be granted retroactively. If you would like to know more about West Chester University's Services for Students with Disabilities (OSSD), please visit them at 223 Lawrence Center. Their phone number is 610-436-2564, their fax number is 610-436-2600, their email address is ossd@wcupa.edu, and their website is at <https://www.wcupa.edu/universityCollege/ossd/>. In an effort to assist students who either receive or may believe they are entitled to receive accommodations under the Americans with Disabilities Act and Section 504 of the Rehabilitation Act of 1973, the University has appointed a student advocate to be a contact for students who have questions regarding the provision of their accommodations or their right to accommodations. The advocate will assist any student who may have questions regarding these rights. The Director for Equity and Compliance/Title IX Coordinator has been designated in this role. Students who need assistance with their rights to accommodations should contact them at 610-436-2433.

EXCUSED ABSENCES POLICY

Students are advised to carefully read and comply with the excused absences policy, including absences for university-sanctioned events, contained in the WCU Undergraduate Catalog. In particular, please note that the "responsibility for meeting academic requirements rests with the student," that this policy does not excuse students from completing required academic work, and that professors can require a "fair alternative" to attendance on those days that students must be absent from class in order to participate in a University-Sanctioned Event.

REPORTING INCIDENTS OF SEXUAL VIOLENCE

West Chester University and its faculty are committed to assuring a safe and productive educational environment for all students. In order to comply with the requirements of Title IX of the Education Amendments of 1972 and the University's commitment to offering supportive measures in accordance with the new regulations issued under Title IX, the University requires faculty members to report incidents of sexual violence shared by students to the University's Title IX Coordinator. The only exceptions to the faculty member's

reporting obligation are when incidents of sexual violence are communicated by a student during a classroom discussion, in a writing assignment for a class, or as part of a University-approved research project. Faculty members are obligated to report sexual violence or any other abuse of a student who was, or is, a child (a person under 18 years of age) when the abuse allegedly occurred to the person designated in the University Protection of Minors Policy. Information regarding the reporting of sexual violence and the resources that are available to victims of sexual violence is set forth at:

<https://www.wcupa.edu/admin/diversityEquityInclusion/sexualMisconduct/default.aspx>

INCLUSIVE LEARNING ENVIRONMENT AND ANTI-RACIST STATEMENT

Diversity, equity, and inclusion are central to West Chester University's mission as reflected in our [Mission Statement](#), [Values Statement](#), [Vision Statement](#) and [Strategic Plan: Pathways to Student Success](#). We disavow racism and all actions that silence, threaten, or degrade historically marginalized groups in the U.S. We acknowledge that all members of this learning community may experience harm stemming from forms of oppression including but not limited to classism, ableism, heterosexism, sexism, Islamophobia, anti-Semitism, and xenophobia, and recognize that these forms of oppression are compounded by racism. Our core commitment as an institution of higher education shapes our expectation for behavior within this learning community, which represents diverse individual beliefs, backgrounds, and experiences. Courteous and respectful behavior, interactions, and responses are expected from all members of the University. We must work together to make this a safe and productive learning environment for everyone. Part of this work is recognizing how race and other aspects of who we are shape our beliefs and our experiences as individuals. It is not enough to condemn acts of racism. For real, sustainable change, we must stand together as a diverse coalition against racism and oppression of any form, anywhere, at any time.

Resources for education and action are available through WCU's [Office for Diversity, Equity, and Inclusion](#) (ODEI), DEI committees within departments or colleges, the student [ombudsperson](#), and centers on campus committed to doing this work (e.g., [Dowdy Multicultural Center](#), [Center for Women and Gender Equity](#), and the [Center for Trans and Queer Advocacy](#)).

Guidance on how to report incidents of discrimination and harassment is available at the University's [Office of Diversity, Equity and Inclusion](#).

EMERGENCY PREPAREDNESS

All students are encouraged to sign up for the University's free WCU ALERT service, which delivers official WCU emergency text messages directly to your cell phone. For more information, visit www.wcupa.edu/wcualert. To report an emergency, call the Department of Public Safety at 610-436-3311.

ELECTRONIC MAIL POLICY

It is expected that faculty, staff, and students activate and maintain regular access to University provided e-mail accounts. Official university communications, including those from your instructor, will be sent through your university e-mail account. You are responsible for accessing that mail to be sure to obtain official University communications. Failure to access will not exempt individuals from the responsibilities associated with this course.