

# Numerical Analysis

## Foundations of Computational Mathematics

### MATH 420–01 and CYBR 304–01

### Spring 2024

**Instructor:** Barton Willis, PhD, Professor of Mathematics

**Office:** Discovery Hall, Room 368

**Office Hours:** Monday, Wednesday, and Friday 9:00 AM—11:00 AM, Tuesday and Thursday 9:30 AM—11:00 AM, and by appointment.

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**🌐** <https://github.com/barton-willis/MATH-420-CYBR-304>

### Important Dates

<b>First homework due</b> .....	27 January
<b>Exam I</b> .....	23 February
<b>Exam II</b> .....	5 April
<b>Exam III</b> .....	5 May
<b>Final exam</b> .....	13 May 8:00 AM—10:00 AM

### Grading

Your course grade will be based on eleven homework sets, three midterm exams, and a comprehensive final exam; specifically:

<b>Weekly Homework:</b> <i>11 twenty point assignments</i> .....	220 (total)
<b>Mid-term exams I, II, III:</b> <i>100 points each</i> .....	300 (total)
<b>Comprehensive Final exam</b> .....	150 (total)

If we end the term with less than 220 points for homework, your homework point total will be scaled to 220 points. There will be a five point bonus that is due the first week of the term.

The following table shows the *minimum* number of points (out of 670) that are required for each of the twelve letter grades D- through A+. For example, a point total of 581 points will earn you a grade of B+, and a point total of 603 points will earn you a grade of A-. If you earn a point total of 401 or less, you will a failing course grade.

D- .....	402	B- .....	536
D .....	424	B .....	558
D+ .....	447	B+ .....	581
C- .....	469	A- .....	603
C .....	491	A .....	625
C+ .....	514	A+ .....	663

### Course Calendar

We will try to adhere to the following schedule, but we will modify it if needed. The exam dates will only be changed for a compelling reason; we won't delay an exam because we are behind the schedule. Neither will an exam date be moved forward because we are ahead of the schedule.

Homework assignments are due at 11:59 PM local time on Saturday on the week they are assigned.

Week	Week	Section(s)	Topic(s)	Assessment
1	1/22	\$1.1, \$1.3	Floating point numbers & calculus tools	<b>HW 1</b>
2	1/29	\$1.2	Introduction to Julia	<b>HW 2</b>
3	2/5	\$2.1	Errors and convergence rates	<b>HW 3</b>
4	2/12	\$2.2 – \$2.7	Root Finding	<b>HW 4</b>
5	2/19	\$2.2–\$2.7	Root Finding	<b>Exam I, 23 Feb</b>
6	2/26	class notes	Linear equations	<b>HW 5</b>
7	3/4	class notes	Linear equations	<b>HW 6</b>
8	3/18	\$3.1–\$3.4	Interpolation	<b>HW 7</b>
9	3/25	\$3.1 – \$3.4	Interpolation	<b>HW 8</b>
10	4/1	\$4.1–\$4.2	Numerical integration	<b>Exam II, 5 April</b>
11	4/8	\$4.3 –\$4.4	Gaussian integration & multiple integrals	<b>HW 9</b>
12	4/15	\$5.1–\$5.2	Discrete & continuous least squares	<b>HW 10</b>
13	4/22	\$5.3	Orthogonal polynomials and least squares	<b>HW 11</b>
14	4/29	class notes	Differential equations	<b>Exam III, 3 May</b>
15	5/6	class notes	Differential equations	
16	5/13			<b>Final 13 May, 8:00 am–10:00 am</b>

### Class meeting time and place

This class meets Monday, Wednesday, and Friday from 8:00 AM– 8:50 AM in Discovery Hall, room 116.

### Course Objectives

On completion of this course, students will

- understand IEEE arithmetic and know the rules for accurate computation.
- understand the concepts of linear and quadratic convergence and use these concepts to analyze the efficiency of an algorithm.
- develop an understanding of the algorithms for solving linear and nonlinear equations, interpolation, quadrature, least squares methods, and solution of differential equations.
- be able to use a programming language and graphical tools to solve problems numerically.

### Course Resources

- Our textbook is *First Semester in Numerical Analysis with Julia*, by Giray Ökten. This is an open-source textbook that can be legally downloaded, printed, and used without payment.<sup>1</sup> For topics not covered in our textbook, we'll use class notes and other freely available resources.
- Class notes that are written on the board or distributed via Canvas.
- Reliable Internet access.
- An Internet connected computer (not just a phone or tablet) that can run the Juila Language. Both are free resources; download and install Julia it from <https://julialang.org/downloads/>. I suggest that you install version 1.10.0.
- Pencils, erasers, notebook for note taking. Colored pens or pencils are nice for note taking.

<sup>1</sup><https://diginole.lib.fsu.edu/islandora/object/fsu:657877/datastream/PDF/view>

## Class Policies

Unless an assessment is *explicitly* stated to be a group project, *all work you turn in for a grade must be your own*. If you need assistance in completing a homework assignment, you may ask me for help. Using solution keys from previous terms (either from UNK or other universities) is prohibited. Violation of these rules will result in earning a grade of zero on the assessment. Each homework assignment you turn in for a grade must include the statement:

I have neither given nor received unauthorized assistance on this assignment.

If two assignments are so similar that only collaboration could explain their similarities, both assignments will receive a grade of zero. Using unauthorized materials or communication devices (cell phone, for example) while taking a test will earn you a grade of zero on that assessment.

1. Regular in person class attendance is required. If you are ill or need to miss a class due to athletics, please let me know ahead of time and I will make an effort to put the class on Zoom. Additionally, when you miss class, please ask a classmate to take class notes for you. My class notes are intended for my use and they are *not* a good guide to our class, so generally I will not provide you with my class notes.
2. For examinations and in class assignments, show your work. *No credit will be given for multi-step problems without the necessary work. Your solution must contain enough detail so that I am convinced that you could correctly work any similar problem.* Also erase or clearly mark any work you want me to ignore; otherwise, I'll grade it.
3. The work you turn in is expected to be *accurate, complete, concise, neat, and well-organized. You will not earn full credit on work that falls short of these expectations.*
4. Class cancellations due to weather, illness, or other unplanned circumstances may require that we make adjustments to the course calendar, exam dates, and due dates or specifics for course assessments.
5. Extra credit is not allowed. Redoing an assessment to earn a higher grade is not allowed.
6. I will accept homework that is submitted late only with prior approval and for a good and substantial reason. Homework that is submitted late with no prior approval will not be graded and will earn you a grade of zero.
7. For examinations, you may use a teacher provided quick reference sheet (if any) but no other reference materials. You may also use a pencil, eraser, and a scientific calculator. For examinations, your phone and all such devices must be turned off and *out of sight*.
8. Generally, if you are ill or absent for any reason (including athletics), you must turn in your in class work on time. Permission to turn in work late must be made in advance, otherwise late in class work will count zero points.
9. During class time, please refrain from using electronic devices. If your device usage distracts your classmates, I will ask you to put it away. If it's my impression that you are often not paying attention in class, I reserve the right to decline to help you during office hours.
10. The final examination will be *comprehensive* and it will be given during the time scheduled by the University. Except for *extraordinary circumstances* you must take the exam at this time.
11. If you have questions about how your work has been graded, make an appointment with me immediately.
12. Please regularly check Canvas to verify that your scores have been recorded correctly. If I made a mistake in recording one of your grades, I'll correct it provided you saved your paper.

## University Policies<sup>2</sup>

**Student Attendance Policy Statement** Students are expected to attend all meetings of classes for which they are registered, including the first and last scheduled meetings and the final examination period. Instructors hold the right and responsibility to establish attendance policies for their courses. Each instructor must inform all classes at the beginning of each semester concerning their attendance policies.

Participation in official University activities, serious health concerns, personal emergencies, and religious observances are valid reasons for absence from classes. Students are responsible for informing their instructors prior to their absence(s) from class and for completing assignments missed during their absence(s). No adverse or prejudicial effects shall result to any student with a documented, excused absence.

Questions may be directed to the Dean of Student Affairs office or to Student Health & Counseling.

**Academic Integrity Policy** The maintenance of academic honesty and integrity is a vital concern of the University community. Any student found in violation of the standards of academic integrity may be subject to both academic and disciplinary sanctions. Academic dishonesty includes, but is not limited to, the following:

- **Cheating** Copying or attempting to copy from an academic test or examination of another student; using or attempting to use unauthorized materials, information, notes, study aids or other devices for an academic test, examination or exercise; engaging or attempting to engage the assistance of another individual in misrepresenting the academic performance of a student; or communicating information in an unauthorized manner to another person for an academic test, examination or exercise.
- **Fabrication and falsification** Falsifying or fabricating any information or citation in any academic exercise, work, speech, test or examination. Falsification is the alteration of information, while fabrication is the invention or counterfeiting of information.
- **Plagiarism** Presenting the work of another as one's own (i.e., without proper acknowledgment of the source) and submitting examinations, theses, reports, speeches, drawings, laboratory notes or other academic work in whole or in part as one's own when such work has been prepared by another person or copied from another person.
- **Abuse of academic materials and/or equipment** Destroying, defacing, stealing, or making inaccessible library or other academic resource material.
- **Complicity in academic dishonesty** Helping or attempting to help another student to commit an act of academic dishonesty.
- **Falsifying grade reports** Changing or destroying grades, scores or markings on an examination or in an instructor's records.
- **Misrepresentation to avoid academic work** Misrepresentation by fabricating an otherwise justifiable excuse such as illness, injury, accident, etc., in order to avoid or delay timely submission of academic work or to avoid or delay the taking of a test or examination.
- **Other Acts of Academic Dishonesty** Academic units and members of the faculty may prescribe and give students prior written notice of additional standards of conduct for academic honesty in a particular course, and violation of any such standard shall constitute a violation of the Code.

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<sup>2</sup>These policies are copied from <https://catalog.unk.edu/undergraduate/academics/academic-regulations/> and from [https://www.unk.edu/academic\\_affairs/asa\\_forms/course-policies-and-resources.php](https://www.unk.edu/academic_affairs/asa_forms/course-policies-and-resources.php). As of 29 May 2024, these policies are current.

Under Section 2.9 of the Bylaws of the Board of Regents of the University of Nebraska, the respective colleges of the University have responsibility for addressing student conduct solely affecting the college. Just as the task of inculcating values of academic honesty resides with the faculty, the college faculty are entrusted with the discretionary authority to decide how incidents of academic dishonesty are to be resolved. For more information, please visit UNK's Procedures and Sanctions for Academic Integrity and the Student Code of Conduct.

**Reporting Student Sexual Harassment, Sexual Violence or Sexual Assault** Reporting allegations of rape, domestic violence, dating violence, sexual assault, sexual harassment, and stalking enables the University to promptly provide support to the impacted student(s), and to take appropriate action to prevent a recurrence of such sexual misconduct and protect the campus community. Confidentiality will be respected to the greatest degree possible. Any student who believes they may be the victim of sexual misconduct is encouraged to report to one or more of the following resources:

- Local Domestic Violence, Sexual Assault Advocacy Agency 308-237-2599
- Campus Police (or Security) 308-865-8911
- Title IX Coordinator 308-865-8655

Retaliation against the student making the report, whether by students or University employees, will not be tolerated.

**Students with Disabilities** It is the policy of the University of Nebraska at Kearney to provide flexible and individualized reasonable accommodation to students with documented disabilities. To receive accommodation services for a disability, students must be registered with the UNK Disabilities Services for Students (DSS) office, 175 Memorial Student Affairs Building, 308-865-8214 or by email [unkdso@unk.edu](mailto:unkdso@unk.edu)

**Students Who are Pregnant** It is the policy of the University of Nebraska at Kearney to provide flexible and individualized reasonable accommodation to students who are pregnant. To receive accommodation services due to pregnancy, students must contact the Student Health office at 308-865-8218. The following links provide information for students and faculty regarding pregnancy rights:

- <https://thepregnantscholar.org/title-ix-basics/>
- <https://nwlc.org/resource/faq-pregnant-and-parenting-college-graduate-students-rights/>

**UNK Statement of Diversity & Inclusion** UNK stands in solidarity and unity with our students of color, our Latinx and international students, our LGBTQIA+ students and students from other marginalized groups in opposition to racism and prejudice in any form, wherever it may exist. It is the job of institutions of higher education, indeed their duty, to provide a haven for the safe and meaningful exchange of ideas and to support peaceful disagreement and discussion. In our classes, we strive to maintain a positive learning environment based upon open communication and mutual respect. UNK does not discriminate on the basis of race, color, national origin, age, religion, sex, gender, sexual orientation, disability or political affiliation. Respect for the diversity of our backgrounds and varied life experiences is essential to learning from our similarities as well as our differences. The following link provides resources and other information regarding D&I: <https://www.unk.edu/about/equity-access-diversity.php>.