COURSE OUTLINE

Math 464, Spring 2022
Numerical Analysis I

Time: MWF 2:30-3:20pm
Room: Communications (CMU) 120

Instructor: Prof. Ken Bube
E-mail: bube@uw.edu

TAs: Yiping Hu, huypken@uw.edu
Angel Burr, arburr@uw.edu

Main course website: http://canvas.uw.edu
Supplementary materials website: https://sites.math.washington.edu/~bube/m464sp22/

Welcome to Math 464 in Spring 2022! Our course will be run in "mixed" mode. Our regularly scheduled class meetings (Monday, Wednesday, Friday, 2:30pm - 3:20pm in CMU 120) will be less formal than traditional lectures: we will discuss an overview of the material covered in the day's lecture and there will be plenty of time for questions on lectures, homework, or other aspects of our course. For a thorough covering of the material, lecture notes with "talk-through" audio files will be provided to serve as our course lectures. These can be read/listened to outside of "classtime" (asynchronously). The main website for our course will be our course Canvas website; please check it regularly. In addition, we have a supplementary materials website, where course material files will be easily available. I thank you all in advance for your patience as we all try to navigate our way this quarter. We have some very interesting material for you to learn, and I believe that together we can make this course work well for you.

Text: L. W. Johnson and R. D. Riess, *Numerical Analysis*, 2nd edition, Addison–Wesley, 1982.
This book is out of print, but you might find a copy online (make sure it is the 2nd ed.).
Important selections are posted on the supplementary materials website.

Supplementary notes are posted on the supplementary materials website.

References: Here are some other good references to be aware of on the material we are studying this quarter. [1, 2, and 4] are classic general numerical analysis texts; [3] is a text on numerical linear algebra.

[1] S. D. Conte and C. de Boor, *Elementary Numerical Analysis: An Algorithmic Approach*, 3rd edition, McGraw-Hill, 1980.
[2] G. Dahlquist, A. Bjorck, and N. Anderson, *Numerical Methods*, Prentice-Hall, 1974.
[3] G. E. Forsythe and C. B. Moler, *Computer Solution of Linear Algebraic Systems*, Prentice-Hall, 1967.
[4] E. Isaacson and H. B. Keller, *Analysis of Numerical Methods*, John Wiley, 1966.

Material: We will cover most of chapters 1–2 and 4–6 in Johnson and Riess. This includes: number representation, error analysis, solution of systems of linear equations, solution of nonlinear equations, interpolation and approximation, numerical differentiation and integration. The following is a tentative schedual for when the material will be covered in lecture notes/talk-through audios. Please read the sections in the book in the week they are covered.

Dates	Sections	Dates	Sections
Mar 28 – Apr 1	1.1–4	May 2 – 6	4.1–3
Apr 4 – 8	2.1–2	May 9 – 13	4.3–4
Apr 11 – 15	2.2–3	May 16 – 20	5.1–2
Apr 18 – 22	2.3–4,	May 23 – 27	6.1–4
Apr 25 – 29	2.5, Review,EXAM	Jun 1 – 3	Review

Grading: Problem Sets: 30%, Midterm Exam: 30%, Final Exam: 40%

Exams: Midterm Exam: Friday, April 29, in class (2:30-3:20pm) in CMU 120–covers through Section 2.5
Final Exam: Tuesday, June 7, 2:30–4:20pm in CMU 120–covers whole course

Homework: There will be seven Problem Sets, listed on the back of this outline. Plan to finish as much as you can on each problem set by a couple of days before it is due; do not leave it all to the last night.
The problem sets will be turned in as Assignments on Canvas – see Canvas for details.

Problem Sets

Problem Sets will be turned in as Assignments on Canvas. Please submit a sinlge pdf file for each assignment. The homework problems can be quite challenging, as appropriate for a 400-level course. They require some thought on your part, building from our course material. Questions are welcome in our class sessions to help.

	Date Due	Section	Problems
Problem Set 1	Due Fri, Apr 8:	§**1.3**	# 1, 4, 5, 6, 8
		§**2.1**	# 3, 4, 6, 10, 11
Problem Set 2	Due Fri, Apr 22:	§**2.2.4**	# 4, 5, 9, 10
		§**2.3**	# 3, 7, 8, 9, 18
Problem Set 3	Due Mon, May 2:	§**2.4**	# 5, 7, 9, 13
		§**2.5**	# 1, 3, 4, 5a, 6a
Problem Set 4	Due Fri, May 13:	§**4.3.1**	# 1, 4, 6, 9
		§**4.3.3**	# 2, 7, 12
Problem Set 5	Due Fri, May 20:	§**4.4.1**	# 2, 3, 4
		§**5.1**	# 4
		§**5.2.1**	# 1a, 3a, 4a, 11
Problem Set 6	Due Fri, May 27:	§**5.2.2**	# 1, 5, 8, 10
		§**5.2.4**	# 3, 5, 6, 10
		§**5.2.6**	# 1, 3
Problem Set 7	Due Fri, Jun 3:	§**6.2.2**	# 2, 4, 9
		§**6.2.4**	# 9, 11
		§**6.4.1**	# 6, 8

Exercises from first lecture (not to be turned in)

1. Show that if $0 \le b_k < \beta$ for $k = 1, 2, \ldots$, and b_k and β are integers with $\beta > 1$, then the series

$$\sum_{k=1}^{\infty} b_k \beta^{-k}$$

   always converges. (Hint: Comparison Test.)

2. Show that x has a terminating expansion in base β if and only if x is rational and when x is expressed in simplest form, the only prime factors of the denominator of x are factors of β.

   Example: $x = 13/40$ has a terminating expansion in base 10 because $40 = 2^3 \cdot 5$, so the only prime factors of 40 are 2 and 5, which are both factors of 10.

3. Show that if x does not have a terminating expansion in base β, then the expansion of x in base β is unique. If $x \neq 0$ has a terminating expansion in base β, show that it has exactly one terminating expansion (ending in zeros) and exactly one nonterminating expansion (ending in $(\beta - 1)$'s).

   Example: $1/8 = (0.125000\ldots)_{10} = (0.124999\ldots)_{10}$

Religious Accomodations: Washington state law requires that UW develop a policy for accommodation of student absences or significant hardship due to reasons of faith or conscience, or for organized religious activities. The UW policy, including more information about how to request an accommodation, is available at Religious Accommodations Policy (https://registrar.washington.edu/staffandfaculty/religious-accommodations-policy/). Accommodations must be requested within the first two weeks of this course using the Religious Accommodations Request form (https://registrar.washington.edu/students/religious-accommodations-request/).