

Linear Algebra - Math 304

Fall 2020 - Course Coordinator: Prof. Alexander Borisov

Sec	Instructor	Office	Phone	Email(*)	Meets	Room
1	Alexander Borisov	online		borisov	MWF:8:00-9:30	online
2	Seunghun Lee	online		shlee	MWF:9:40-11:10	online
3	Fikreab Solomon Admasu	online		fsolomon	MWF:11:20-12:50	online
4	Quincy Loney	online		quincy	MWF:1:10-2:40	online
5	Eugenia Sapir	online		sapir	MWF:2:50-4:20	online
6	Vaidehee Thatte	online		thatte	MWF:4:40-6:10	online

(*): Each email address in this table is of the form xxx@math.binghamton.edu but that should happen automatically if you just click on the link.

If a section has its own detailed syllabus webpage, a link to that page will be provided under the Instructor column of the table above.

Below is a partial syllabus with information for all sections that you should know. Your instructor may have a more detailed syllabus about how your section will be run.

Textbook

“Linear Algebra” by Jim Hefferon, Fourth Edition, available as a free download here:

Linear Algebra by Jim Hefferon.

One can buy a cheap printed version and access more free resources at the textbook's official website.

Here are also some additional books that students and instructors may find helpful.

A First Course in Linear Algebra by Robert A. Beezer

Elementary Linear Algebra by K.R. Matthews

Linear Algebra by D. Cherney, T. Denton, R. Thomas, and A. Waldron

Exam Schedule

Midterm Examination 1: Week of September 21

Midterm Examination 2: Week of October 19

Midterm Examination 3: Week of November 30

Final Exam: December 8-10

Grades

Remote format of the course requires radical steps to combat academic dishonesty and to protect the honest students from unfair competition. To do this, we will have a grading system based primarily on **oral examinations**.

How to study for oral exams

The midterm and the final examinations will be interview-style (**oral**) on Zoom, recorded. Each examination will be scheduled for 15-20 minutes, though it may take longer or shorter. The examinations will be scheduled outside of the instructional time, at a time that works for you and your instructor. All examinations will be **cumulative**. For each examination you will receive a letter grade: A=100%, B=75%, C=50%, D=25%, or F=0%. Final examination grade will not count directly, but will automatically replace one of the midterm grades, to maximize your course total. (If the final examination grade is lower than all your midterm grades, your course total will not change).

The course total will be determined as follows:

WebWork Homework (common for all sections): 3%

Section-specific Homework/Quizzes: 7%

Midterm 1: 20%

Midterm 2: 30%

Midterm 3: 40%

At the end of the course, your grade in the course will be determined by your instructor based primarily on your course total and the following scale (approximate, subject to adjustments):

A 90%, A- 85%, B+ 77.5%, B 72.5%, B- 67.5%, C+ 60%, C 55%, C- 50%, D 37.5%

Homework

Online homework will be done using WebWork. The server address is

<https://webwork.math.binghamton.edu/webwork2/304Fall2020/>

Your WebWork account username is the pre@ portion of your binghamton.edu e-mail account. Your initial password is the same as the username. For example, if your Binghamton e-mail account is xyzw77@binghamton.edu then your username: xyzw77 and your password: xyzw77

Make sure to change your password as soon as possible to a secure password, and save that choice where it will not be lost.

Important: Besides the WebWork homework sets, you should do problems from the book, as selected by your instructor, see an approximate schedule below. This part of the homework will not be graded, but it will be paramount to your success in the course.

Expected workload

You are expected to spend about 12.5 hours per week on average for this class, including participation in Zoom

lectures, watching instructional videos, solving homework problems (graded and ungraded), reviewing the material, and preparing for the tests. Expect the work load to be higher than average in the weeks before the major exams.

Expected behavior in class

During online classes all students are expected to participate in a way that maximizes their learning and minimizes disruptions for their classmates. Your instructor has the final word on the use of video and audio in the general Zoom sessions, break-out rooms, and online office hours. If you have any concerns, limitations, or circumstances, please communicate with your instructor to find the most appropriate solution.

Academic Code of Honor

For all graded assignments and exams, you are not allowed to use any help, that was not explicitly authorized by your instructor. This includes, but is not limited to problem-solving websites, notes, help from other people, etc. All instances of academic dishonesty will be investigated, penalized, and referred to the appropriate University officials for maximal possible punishment. In other words, **don't even think of trying to cheat.**

Getting Help

If you fall behind in class, or need extra help to learn the material, talk to your instructor as soon as you can. They should be able to help you and also point you to other resources. We also encourage you to talk to your classmates, and, in particular, to form informal study groups to prepare for the exams.

Disability Information

If you have a disability for which you are or may be requesting an accommodation, please contact both your instructor and the Services for Students with Disabilities office (119 University Union, 607-777-2686) as early in the term as possible. Note: extended time for the examinations may not automatically apply to the interview-style exams, but we will work with you to provide reasonable accommodations that are appropriate for your situation.

Tentative Schedule

Unless otherwise specified, the Text is the Jim Hefferon's book and the exercises are from there, in the format "Chapter:Section.Subsection.ProblemNumber". It is subject to change and adjustment at your instructor's discretion. The Problems are for practice only and are not to be turned in. There will be separate weekly graded homework through WebWork. Instructional videos for the second half of the semester is **supplementary material**, not intended to replace the regular lectures.

Week	Dates	Topics	Text	Problems
1	Aug 26, 28	Introduction, preview, examples; linear combination	Ch. 1, I.1	1:I.1.17,19,21
		Gaussian elimination (reduction)	Ch. 1, I.1	1:I.1.22,24,27,32

2	Aug 31 - Sep 4	(Augmented) matrix of a system, solution set	Ch. 1, I.2	1:I.2.15,16,17,18,21,25
		Logical statements, basic constructions, quantifiers	Appendix	
		Induction (informal), sets, functions	Appendix	
3	Sep 7- 11	Homogeneous and non-homogeneous systems (no formal induction in Lemma 3.6)	Ch. 1, I.3	1:I.3.15,17,18,20,21,24
		Points, vectors, lines, planes	Ch. 1, II.1	1:II.1.1,2,3,4,7
		Distance, dot product, angles, Cauchy-Schwarz and Triangle Inequalities	Ch. 1, II.2	1:II.2.11,12,14,16,17,21,22
4	Sep 14- 18	Gauss-Jordan reduction, reduced row echelon form	Ch. 1, III.1	1:III.1.8,9,10,12,13,14,15
		Linear combination lemma, uniqueness of RREF (no proofs of 2.5, 2.6)	Ch. 1, III.2	1:III.2.11,14,20,21,24
		Review for Examination 1	Ch. 1; Appendix	Student's_Guide; Sample_Problems; Solutions
5 Exam 1 week	Sep 21- 25	Matrix operations, including the transpose. Linear system as a matrix equation	Matthews 2.1	3:III.1.13,14,15,16
		Linear maps (transformations) given by matrices	Matthews 2.2	3:III.1.19; 3:III.2.12,17,30
		Vector spaces: definition, examples	Ch. 2, I.1	2:I.1.17,18,19,21,22,29,30
6	Sep 28 - Oct 2	Linear maps between vector spaces	Ch. 3, II.1	3:II.1.18,19,20,22,24,25,26,28
		Subspaces. Span	Ch. 2, I.2	2:I.2.20,21,23,25,26,29,44,45
		Linear independence	Ch. 2, II.1	2:II.1.21,22,25,28
7	Oct 5-9	Properties of linear independence	Ch. 2, II.1	2:II.1.29,30,32,33
		Basis of a vector space	Ch. 2, III.1	2:III.1.20,21,22,23,24,25,26,30,31,34
		Dimension of a vector space	Ch. 2, III.2	2:III.2.15,16,17,18,19,20,21,24,25,28
8	Oct 12- 16	Column space, row space, rank	Ch. 2, III.3	2:III.3.17,18,19,20,21,23,29,32,39
		Range space and Kernel (Null space)	Ch. 3, II.2	3:II.2.21,23,24,26,31,35
		Review for Examination 2		Student's_Guide; Sample_Problems; Solutions
9 Exam 2 week	Oct 19- 23	Review for Examination 2		
		Invertible matrices: definition, equivalent conditions; inverse matrix	Ch.3, IV.4	3:IV.4.13,14,15,16,17,18,19,26,29 InvertibleMatrices_1 InvertibleMatrices_2 InvertibleMatrices_3 InvertibleMatrices_4 InvertibleMatrices_5
		Elementary matrices. Row reduction using elementary matrices	Ch. 3, IV.3; CDTW Ch. 2, 2.3	3:IV.3.24,25,32 ElementaryMatrices_1 ElementaryMatrices_2 ElementaryMatrices_3
10	Oct 26- 30	Determinant of a matrix, properties	Ch. 4, I.1, I.2	4:I.1.1,3,4,6,9; 4:I.2.8,9,12,13,15,18 Determinants_1 Determinants_2 Determinants_3 Determinants_4 Determinants_5 Determinants_6
		More on Determinants	Ch. 4, II.1, III.1	4:III.1.11,14,16,17,20,21,22 Determinants_7(Cramer) Determinants_8(Adjoint)
		Matrix of a linear transformation, matrix of the composition, inverse	Ch. 3, III.1, IV.2	3:III.1.13,17,18,19,21,23 Matrix_of_Transformation_1
11	Nov 2-6	Change of basis, similar matrices	Ch. 3, V.1, V.2; Ch. 5, II.1	3:V.1.7,9,10,12; 5:II.1.5,8,11,13,14 Matrix_of_Transformation_2 Matrix_of_Transformation_3 Matrix_of_Transformation_4 Similar_Matrices
		Complex numbers	Matthews 5.1-5.6	Matthews 5.8.1,2,5,6,7,9 Complex_Numbers_1 Complex_Numbers_2 Complex_Numbers_3 Complex_Numbers_4 Complex_Numbers_5
		Review of the Material		

12	Nov 9-13	Eigenvectors, eigenvalues, eigenspaces for matrices and linear operators. Characteristic polynomial	Matthews 6.1, 6.2; Ch. 5, II.3	5:II.3.23,24,25,26,27,28,29,30,31 Eigenvectors_1 Eigenvectors_2 Eigenvectors_3 Eigenvectors_4 Eigenvectors_5
		Diagonalization of matrices	Ch. 5, II.2, II.3	5:II.3.22,33,36,46 Diagonalization_1 Diagonalization_2 Diagonalization_3 Diagonalization_4 Diagonalization_5 Diagonalization_6
		Review of the Material		
13	Nov 16-20	Orthogonal and orthonormal bases of \mathbb{R}^n and its subspaces; orthogonal matrices	Ch. 3, VI.1, VI.2	3:VI.1.6,7,17,19; 3:VI.2.10 Orthogonal_1 Orthogonal_2 Orthogonal_3 Orthogonal_4
		Orthogonal complement of a subspace, orthogonal projection	Ch. 3, VI.3	3:VI.3.11,12,13,14,26,27 Complements_1 Complements_2 Complements_3 Complements_4 Complements_5
		Gram-Schmidt process; orthogonal diagonalization of matrices	Ch. 3, VI.2	3:VI.2.13,15,17,18,19,22 GramSchmidt_1 GramSchmidt_2 OrthogonalDiagonalization_1 OrthogonalDiagonalization_2
14	Nov 23 - 27	NO CLASS		
		NO CLASSES - Thanksgiving Break		
		NO CLASSES - Thanksgiving Break		
15 Exam 3 week	Nov 30 - Dec 4	Review for Examination 3		Student's_Guide; Sample_Book_Problems; Sample_Problems; Solutions
		Review for the Final Examination		
		Review for the Final Examination		
16 Finals week	Dec 7	Review for the Final Examination		
	Dec 8-11	FINAL EXAMINATIONS		

Sample Exams and Other Study Materials

IMPORTANT: Please note that the sample exams below are **traditional** written exams. Our interview-style exams will focus more on understanding and less on calculations.

Examination 1

Sample_1,Answers_1; Sample_2,Answers_2; Sample_3,Answers_3

Examination 2

Being **cumulative**, Examination 2 will cover all the material of Examination 1 as well as additional topics:

Sample_1,Answers_1; Sample_2,Answers_2; Some_Practice_Problems, Answers

Examination 3 and Final Examination

Being **cumulative**, Examination 3 and Final Examination will cover all the material of Examinations 1 and 2 as well as additional topics:

Sample_1, Answers_1; Sample_2, Answers_2; Sample_3, Answers_3

The following sample exams are traditional cumulative final exams. They are adapted, with permission, from the collection of Dr. Inna Sysoeva

Sample_1, Answers_1; Sample_2, Answers_2; Sample_3, Answers_3; Sample_4, Answers_4; Sample_5, Answers_5 |

Syllabi from previous semesters

The syllabus for Math 304 in Fall 2019 is available through this link:

[Spring 2020 page](#)

The syllabus for Math 304 in Fall 2019 is available through this link:

[Fall 2019 page](#)

The syllabus for Math 304 in Spring 2019 is available through this link:

[Math 304 Syllabus for Spring 2019](#)

The syllabus for Math 304 in Fall 2018 is available through this link:

[Fall 2018 page](#)

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