Linear Algebra - Math 304

Spring 2020 - Course Coordinator: Prof. Alexander Borisov

Sec	Instructor	Office	Phone	Email(*)	Meets	Room
1	Alexander Borisov	WH-109	777-2764	borisov	MWF:8:00-9:30	SL-302
2	Casey Donoven	WH-202	777-2982	cdonoven	MWF:8:00-9:30	WH-G002
3	David Biddle	WH-126		biddle	MWF:9:40-11:10	AA-G021
4	Charles (Matt) Evans	WH-380		evans	MWF:11:20-12:50	LH-12
5	David Biddle	WH-126		biddle	MWF:11:20-12:50	AA-G021
6	Alex Feingold	WH-115	777-2465	alex	MWF:1:10-2:40	SL-302
7	Thomas Kilcoyne	WH-336		kilcoyne	MWF:2:50-4:20	LH-12
8	Thomas Kilcoyne	WH-336		kilcoyne	MWF:4:40-6:10	LH-12

(*): 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.

Important: Syllabus Adjustments due to the Coronavirus Epidemic

Syllabus Addition for MATH 304, due to the Online Instruction Mode

The following changes will be implemented in all sections of MATH 304, effective 03/19/2020.

1) Instead of the regular classes, the instructors will be holding online office hours, using Zoom or alternative software. These online office hours will be held during the regular instructional times. Additional online office hours may be scheduled as needed. In addition to the recommended textbook reading, there will be links to videos posted online. You are responsible for learning the material on your own, and using the online office hours to clarify any questions that you may have.

2) Instead of the in-class quizzes you will be getting homework assignments, through WebWork, MyCourses, or other system, at your instructor's discretion. These assignments are on top of the regular WebWork homework, and they will differ by section and may have shorter deadlines.

3) Midterm examinations and final examination will be conducted in a various remote formats, depending on the section. Your instructor will provide you with the details.

4) Since we are unable to hold a common in-class final examination, the one-letter-grade rule from the original syllabus will not apply.

5) It is your responsibility to inform your instructor of any circumstances that hinder or jeopardize your participation in the course, including any computer-related issues. The instructors and the course coordinator will do their best to help you learn and have a successful semester.

Consider the current situation, as unfortunate as it is, as an opportunity to develop a valuable skill of learning

independently. It is, actually, one of the main goals of college education, much more important than any specific knowledge in any course.

Textbook

``Linear Algebra" by Jim Hefferon, Third Edition, available as a free download here:

Linear Algebra by Jim Hefferon.

Students can also buy a cheap printed version from the link on the author's 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

Only the Final Exam will be common to all sections, but we expect each section will administer other exams on the same day, three times during the semester, as follows:

Exam 1: February 17 or 19 (depending on section)

Exam 2: March 18 This Exam will have to be given online since all classes March 17, 18 have been cancelled.

Exam 3: April 22 or April 24, depending on your section. This Exam will have to be given online.

Final Exam: Thursday, May 7, 8:00-10:00 AM, will be given online.

Arrangements for online exams will be announced soon. It is your instructor's responsibility to find a way to administer such exams, get the results and return the graded exam results.

Grade Distribution and Policies

The course total will be determined as follows:

Homework: 5%

Quizzes: 20% (the number and scope to be determined by your instructor)

Exam 1, 2, and 3: 15% each

Final Exam: 30%

The general grade cutoffs are going to be the following:

90% A; 80% B; 70% C; 60% D; and proportional cutoffs for A-,B+,B-,C+, and C-.

These cutoffs may be relaxed at the end of the semester, and may also differ a bit from section to section.

This rule from the original syllabus will not apply: (Additionally, the following one-letter-grade rule will apply: the grade in the course cannot exceed the grade on the final examination by more than one letter grade. For example, if you get a grade of B- on the final, the highest grade you can get in the course is A-. Note that the rule only works one way: even if you get an A on the final, you may still, theoretically, fail the course. The purpose of this rule is to bring some uniformity to the grading, considering that each section will have their own exams, quizzes, and cutoffs.)

Homework

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

https://webwork.math.binghamton.edu/webwork2/304Spring2020/

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.

Besides the online 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 outside of the classroom

This class is scheduled to meet three times per week for 90 minutes each time. In addition to attending all classes, you should expect to need 8 to 10 hours per week outside of the class meetings to study the material and do homework.

Expected behavior in class

During classes all students are expected to behave according to university rules. Your instructor makes the final decisions about what to allow in the classroom, regarding in particular cell phone and laptop use, and food and beverage consumption. If you have any temporary of permanent needs that may necessitate an exception, it is your responsibility to discuss the matter with your instructor in advance.

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.

Announcements

January 22 First Day of Classes: After meeting your instructor you should have been given this webpage address to check for the syllabus and instructions. Step 1: Read the entire syllabus, including the detailed syllabus for your section. Step 2: Set up your WebWork account for doing homework assignments. Step 3: Attend all classes and keep up with all homework corresponding to your section lectures.

February 11: Prof. Borisov will hold a review for all MATH 304 students on Sunday, Feb. 16, at 1:00-3:00 pm, in LH-14. The review session will be based entirely on student's questions, the posted sample exams or any other sources.

March 16: Today the administration announced that all classes (in person and online) have been cancelled for March 17 and 18, so that online only classes will begin March 19. That prevents having the scheduled March 18 Exam 2 in class. Each instructor will tell their students how Exam 2 will be handled.

March 30: Lectures of Prof. Feingold (Section 6) recorded on Panopto as well as written lecture notes are available through links on his webpage: Feingold Section 6 Webpage. These recordings are 90-minute class lectures presented online including interactions with students, and the written lecture notes are copies of the pages shown during the lectures.

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. NOTE: The Problems are for practice only and are not to be turned in. There will be separate weekly GRADED HOMEWORK through WebWork. Many of the examination problems will be similar to these practice problems and/or the WebWork problems.

Week	Dates	Topics	Text	Problems
1	Jan 22, 24	Introduction, preview, examples; linear combination	Ch. 1, I.1	1:I.1.17,1.19,1.21
		Gaussian elimination (reduction)	Ch. 1, I.1	1:I.1.22,24,27,32
2	Jan 27-31	(Augmented) matrix of a system, solution set	Ch. 1, I.2	1:I.2.15,16,17,18,20,23
		Logical statements, basic constructions, quantifiers	A-1, A-2	
		Induction (informal), sets, functions	A-3, A-4	
3	Feb 3-7	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	Feb 10-14	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 (skip 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	Sample_1,Answers_1; Sample_2,Answers_2; Sample_3,Answers_3

5	Feb 17-21	Examination 1	Jan 22 – Feb 14	
		Matrix operations, including the transpose. Linear system as a matrix equation	Matthews 2.1	3:III.1.12,13,14,15
		Linear maps (transformations) given by matrices	Matthews 2.2	3:III.1.18; 3:III.2.17,30
6	Feb 24-28	Vector spaces: definition, examples	Ch. 2, I.1	2:I.1.17,18,19,21,22,29,30
		Subspaces. Span	Ch. 2, I.2	2:I.2.20,21,23,25,29,44
		Linear independence	Ch. 2, II.1	2:II.1.20,21,24,27
7	Mar 2,4	Properties of linear independence	Ch. 2, II.1	2:II.1.28,29,31,32
		Basis of a vector space	Ch. 2, III.1	2:III.1.18,19,20,21,22,23,24,28,29,32
–	Mar 6	No class	Winter Break	
8	Mar 9-13	Dimension of a vector space	Ch. 2, III.2	2:III.2.16,17,18,19,22,23,26,29
		Column space, row space, rank	Ch. 2, III.3	2:III.3.17,18,19,20,21,23,29,32,39
		Range space and null space	Ch. 3, II.2	3:II.2.21,23,24,26,31,35
9	Mar 16-20	Review for Examination 2		Sample_1,Answers_1; Sample_2,Answers_2; Some_Practice_Problems, Answers
		Examination 2	Feb 19 – Mar 16	
		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
10	Mar 23-27	Elementary matrices. Row reduction using elementary matrices	Ch. 3, IV.3; CDTW Ch. 2, 2.3	3:IV.3.24,25,34; ElementaryMatrices_1 ElementaryMatrices_2 ElementaryMatrices_3
		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)
11	Mar 30-Apr 3	Linear maps (transformations) between general vector spaces	Ch. 3, II.1	3:II.1.18,19,20,25,26,28
		Matrix of a linear transformation, matrix of the composition, inverse	Ch. 3, III.1, IV.2	3:III.1.12,14,15,18,19,20,21,22,26,29 Matrix_of_Transformation_1
		Change of basis, similar matrices	Ch. 3, V.1, V.2; Ch. 4, I.1	3:V.1.7,9,10,11; 4:I.1.5,8,11,13,14 Matrix_of_Transformation_2 Matrix_of_Transformation_3 Matrix_of_Transformation_4 Similar_Matrices
–	Apr 4-12	No Class	Spring Break	
12	Apr 13-17	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
		Eigenvectors, eigenvalues, eigenspaces for matrices and linear operators. Characteristic polynomial	Matthews 6.1, 6.2; Ch. 5, II.3	5:II.3.23,26,27,28,29,30,33 Eigenvectors_1 Eigenvectors_2 Eigenvectors_3 Eigenvectors_4 Eigenvectors_5
		Diagonalization of matrices	Ch. 5, II.2, II.3	5:II.3.21,32,35,40,41,44 Diagonalization_1 Diagonalization_2 Diagonalization_3 Diagonalization_4 Diagonalization_5 Diagonalization_6
13	Apr 20-24	Review for Examination 3		Sample_1, Answers_1; Sample_2, Answers_2; Sample_3, Answers_3
		Examination 3	Mar 20 – Apr 20	
		Orthogonal and orthonormal bases of R^n and its subspaces; orthogonal matrices	Ch. 3, VI.1, VI.2	3:VI.1.6,7,17,19; 3:VI.2,10,11,12; Orthogonal_1 Orthogonal_2 Orthogonal_3 Orthogonal_4
14	Apr 27-May 1	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
		Review for the Final Examination		

15	May 4	Review for the Final Examination		Sample exams 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
	Thu. May 7	8:00-10:00 am GW 69EX	Cumulative Final Exam	

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Syllabi from previous semesters

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