

## Math 15a: Applied Linear Algebra Spring 2020

MWTh 1:00pm-1:50pm

Gerstenzang 121

Instructor: Youngmin Park  
E-mail: [ypark@brandeis.edu](mailto:ypark@brandeis.edu)  
Web: [youngmp.github.io/teaching.html](http://youngmp.github.io/teaching.html)  
Office Hours: Th 2-3 (In classroom), Fri 3-4 (In office Goldsmith 118b)

**Course Description** Students in Math 15a will learn the fundamentals of vectors and matrices including linear independence/dependence, change of basis, linear maps, and eigenvectors and eigenvalues.

**Prerequisite** Any calculus course (MATH 10a or 10b) or higher, or precalculus (MATH 5a) and permission of the instructor.

**Textbook** (Required) Otto Bretscher, Linear Algebra with Applications, Fourth Edition. We will use the textbook as a primary reference. I will post relevant excerpts from other material if needed. Lectures and homework assignments will be based directly on the textbook.

**Grading** Your grade will be based on your homework, two midterm exams, and the final exam, according to the following scheme:

- Midterm 1: Thursday, Feb. 27th, 20%
- Midterm 2: Thursday, Mar. 26th, 20%
- Final exam: During Math Common Exams block, as scheduled by the registrar, 40%
- Written assignments/homework assignments: 20%

Your percentage is not the only factor used to determine your letter grade. The final letter grade at the end of the semester will be determined by your percentage and the overall difficulty of the material. If a student earns a 90% in the course then they will not receive a letter grade lower than an A-, 80% guarantees a B-, and so on. However, it is possible that the requirement for an A- or some other letter grade is lowered due to the difficulty of the material. In short, the best way to guarantee the highest possible letter grade you are capable of earning is to learn the material. (Adapted from Jonathan Rachowicz's syllabus)

**Homework** Homework will be collected every week unless stated otherwise. You may collaborate on homework, but make sure that the answers that you submit are your own. Please list the names of the people with whom you collaborated; they deserve to be acknowledged! Your lowest homework grade will be dropped. Always write your answers neatly and show all your work; points will be deducted if the grader cannot follow your reasoning. You will not receive credit for problems that were not assigned, so be sure to read the assignment carefully. Also, please staple your homework if it contains multiple

pages. (Adapted from Adam Levine's Math 15a Syllabus).

Late assignments will be penalized 20% per (calendar) day beginning with the start of class. If you submit your assignment after the end of class it will be graded out of 80%. 24 hours later you will be graded out of 60% and so on. Exceptions and extensions will be determined on a case-by-case basis, but they will require a medical or serious personal issue. I always accept pictures of assignments if you are unable to attend class. Please make sure the pictures are clear enough to read.

I will drop two of the lowest scoring homework assignments.

**Exams** During an exam you are not permitted to bring/use a calculator, notes, scratch paper, smartwatch, cell phone, laptop, etc. This list is not exhaustive. If you are unsure whether or not you may use something on the exam, please ask before the exam. Scratch paper will be provided. One student at a time will be permitted to use the restroom so plan accordingly. (Adapted from Jonathan Rachowicz's syllabus)

**Disability** If you have a disability for which you are or may be requesting an accommodation, you should contact Beth Rodgers-Kay in the Office of Academic Services at 63470 or at [brodgers@brandeis.edu](mailto:brodgers@brandeis.edu). Letters of accommodations should be presented at the start of the semester to ensure provision of accommodations. Accommodations cannot be granted retroactively.

**Academic Integrity** Cheating/plagiarism will not be tolerated. You are expected to follow the University's policy on academic integrity, which is distributed annually as Section 4 of the Rights and Responsibilities Handbook (see <http://www.brandeis.edu/studentaffairs/srcs/rr/index.html>). Instances of alleged dishonesty will be forwarded to the Department of Student Development and Conduct for possible referral to the Student Judicial System. Potential sanctions include failure in the course and suspension from the University.

	Dates	Topics	Sections	Homework
Week 1	1/13, 1/15, 1/16	Course introduction, systems of linear equations, Gaussian elimination, matrix algebra	1.1, 1.2, 1.3, 2.3	Homework 1: due 1/22. 1.1: 2, 8, 17, 27 1.2: 2, 4, 10, 29, 30 1.3: 2, 4, 25 (Problem 25 moved to Homework 2)
Week 2	No class on 1/20. 1/22, 1/23	Linear transformations and matrices	2.1, 2.3, 2.4	Homework 2: due 1/27. 1.3: 17, 18, 19, 25 2.1: 13, 14a, (part b for extra credit) 2.3: 13, 14
Week 3	1/27, 1/29, 1/30	Linear transformations, continued	2.2, 2.4	Homework 3: due 2/3. 2.1: 49 2.2: 2, 4 2.3: 29, 35, 39 2.4: 6, 10, 28, 29, 82. Do not solve 82
Week 4	2/3, 2/5, 2/6	Subspaces of $\mathbb{R}^n$ , bases, and dimension	3.1, 3.2, 3.3	Homework 4: due 2/10. 3.1: 6, 8, 14, 16 3.2: 14, 16, extra credit: 6. Do not solve 50
Week 5	2/10, 2/12, 2/13	Subspaces, coordinates	3.3, 3.4	Homework 5: due 2/24. 3.3: 21, 27, 29. Extra credit: 31 <del>3.4: 7, 26, 27, 38, extra credit: 50</del> (For 3.4.27, just write a product of three matrices; you don't have to do the multiplication.)
Week 6	No class 2/17-2/20	-	-	-
Week 7	2/24, 2/26	Orthogonal projections, orthonormal bases, Gram-Schmidt algorithm	5.1, 5.2	No homework assigned this week
	2/27	<b>Midterm 1: Chapters 1-3</b>		
Week 8	3/2, 3/4, 3/5	Orthogonal projections, orthonormal bases, Gram-Schmidt algorithm	5.1, 5.2	Homework 6: due 3/12. 5.1: 2, 5, 16, 17, 27, 28 5.2: 4, 6, 32, 34
Week 9	3/9, 3/11, 3/12	Orthogonal transformations, cross products, least squares	5.3, 5.4, Appendix (pp. 443-445)	Homework 7: due 3/19. 5.3: 3, 4, 36, 40, 41 5.4: 2, 5, 7, 9 Compute the following cross products: (a) $[1, 2, -3] \times [0, 2, 3]$ (b) $[3, 0, 4] \times [1, -2, 2]$
Week 10	3/16, 3/18, 3/19	Determinants	6.1, 6.2, 6.3.	Homework 8: due 3/30 (no late submissions). 6.1: 6, 8, 10, 17, 24, 28, 43, 44 6.2: 8, 10, 14 6.3: 22, 24, 25
Week 11	No class 3/23-3/26	-	-	-
Week	3/30, 4/1,	Eigenvalues and eigenvectors,	7.1, 7.2	Homework 9: due 4/8

12	4/2	continued; introduction to symmetric matrices		7.1: 2, 8, 10, 15, 16 7.2: 15, 16
Week 13	4/6, 4/7, 4/8	Eigenvalues and eigenvectors, continued; introduction to symmetric matrices	7.3, 7.4	Homework 10: due 4/23 7.3: 8, 10, 14, 20, 26 7.4: 8, 12, 24, 32
Week 14	No class 4/13, 4/15	<b>4/16: Midterm 2, Chapters 5 and 6</b>		
Week 15	4/20, 4/22, 4/23	Symmetric matrices	8.1, 8.2	Homework 11: due 4/29. 8.1: 9, 11 8.2: 3, 4, 15
Week 16	4/27, 4/29	Final exam review	1-8	-
Week 17	TBD	<b>Final exam</b> Location TBD		

## Math 0290: Differential Equations Summer 2017

TuTh 6-7:45pm

Alexander J. Allen hall 103

Instructor: Youngmin Park  
E-mail: yop6@pitt.edu  
MAC Hours  
(O'Hara Student Center 215): Mondays 3-4, Thursdays 4-5

**Course Description** This course presents an introduction to the theory of differential equations from an applied perspective. Topics include solution methods to linear and nonlinear ordinary differential equations (ODEs), and qualitative studies of systems of ODEs.

**Prerequisite** Math 0230 or equivalent, with a grade of C or better.

**Textbook** (Required) Polking, Boggess, Arnold *Differential Equations with Boundary Value Problems*, second edition. ISBN 9780131862364.

**Grading, homework, and midterms** We will have weekly quizzes and two midterms. All quiz, midterm, and final grades will be posted to courseweb. Notify me as early as possible if you will miss a quiz or midterm. If you notify me after the quiz or exam date **you will not be allowed to make up quizzes or exams without a valid medical reason**. Since unexpected events happen, I will drop 3 of your lowest quiz scores.

Your course grade is structured as follows:

- Two midterm exams: 30% (15% each)
- Final exam: 40%
- Quizzes: 30%

See the class schedule for the dates of the quizzes and exams. There will be no written homework assignments.

Excellent performance on midterm 1 and/or midterm 2 will grant exemption from solving the corresponding problems on the final. For example, receiving a high score on midterm 1 will allow skipping problems related to quizzes 1-4 with no penalty (problems and corresponding sections will be clearly labeled). Cutoffs for exemption will be determined after grading each midterm.

Each midterm and quiz is closed-book, closed-notes. However, I will provide a formula sheet for you to use freely on the quizzes and exams. You will not be expected to memorize formulas.

**Disability** If you have a disability for which you are or may be requesting an accommodation, you are encouraged to contact both your instructor and the Office of Disability Resources and Services, 140 William Pitt Union (412) 648-7890 as early as possible in the term. See <http://www.studentaffairs.pitt.edu/drsabout>.

**Academic Integrity** Cheating/plagiarism will not be tolerated. Students suspected of violating the University of Pittsburgh Policy on Academic Integrity will incur a minimum sanction of a zero score for the quiz, exam or paper in question. Additional sanctions may be imposed, depending on the severity of the infraction.

## Math 0290: Differential Equations Summer 2016 Schedule

### WEEK 1:

Relevant practice problems: 1.1: 1,3; 2.1: 3,13,15; 2.2: 9,11,17,23; 2.3: 8 (you may use section 2.3 equations 3.5-3.7),11; 2.4: 3,15,39

**Tuesday, May 16:** Lecture on 1.1 Differential equation models, 2.1 Differential equations and solutions. 2.2 Solutions to separable equations

**Thursday, May 18:** Lecture on 2.3 models of motion, 2.4 Linear equations

### WEEK 2:

Class canceled this week

### WEEK 3:

Relevant practice problems: 2.5: 5;2.7: 3,7

**Tuesday, May 30:** Lecture on 2.5 mixing problems, 2.7 Existence and uniqueness of solutions

**Thursday, June 1:** Quiz 1 on sections 2.2, 2.3, 2.4, 2.5, 2.7. Lecture on 3.1 Modeling population growth, 3.3 Personal finance

### WEEK 4:

Relevant practice problems: 3.1: 10,13; 3.3: 3,5; 3.4: 4,12,21

**Tuesday, June 6:** Lecture on 3.4 Electrical circuits, 4.1 Second order equations

**Thursday, June 8:** Quiz 2 on sections 3.1, 3.3, 3.4. Lecture on 4.2 Second order equations and systems, 4.3 Linear, homogeneous equations with constant coefficients

### WEEK 5:

Relevant practice problems: 4.3: 1,10,18; 4.4: 7,11,13,20(a); 4.5: 1,2,19,21

**Tuesday, June 13:** Lecture on 4.4 Harmonic motion, 4.5 Method of undetermined coefficients

**Thursday, June 15:** Quiz 3 on sections 4.3, 4.4, 4.5. Lecture on 4.6 Variation of parameters, 4.7 Forced harmonic motion

### WEEK 6:

Relevant practice problems: 4.6: 3,5,7; 4.7: 3,13

**Tuesday, June 20:** Quiz 4 on section 4.6. Lecture on 5.1 Laplace transform, 5.2 Properties of the Laplace transform. Review for Midterm 1 if time permits.

**Thursday, June 22:** Midterm 1 on topics from quizzes 1-4

### WEEK 7:

Relevant practice problems: 5.1: 5,8,25,29; 5.2: 6,7; 5.3: 11,19; 5.4: 1,19,21

**Tuesday, June 27:** Lecture on 5.3 Inverse Laplace transform, 5.4 Solving ODEs with the Laplace transform

**Thursday, June 29:** Quiz 5 on sections 5.1,5.2,5.3,5.4. Lecture on 5.5 Discontinuous forcing terms, 5.6 Delta function, 5.7 Convolutions

### WEEK 8:

Relevant practice problems: 5.5: 6,10,27; 5.6: 3,5; 5.7: 7,9

**Tuesday, July 4:** No class.

**Thursday, July 6:** Lecture on Chapter 7 matrix algebra boot camp, 8.1 Intro-

duction to systems, 8.2 Geometric interpretation of systems. Review for midterm 2 if time permits.

#### WEEK 9:

Relevant practice problems: 7.1: 1,3; 7.3: 1,3; 7.4:3,4

Decide on extra credit presentation topics by the end of this week.

**Tuesday, July 11:** Midterm 2 on sections 5.1–5.7

**Thursday, July 13:** Lecture on 9.2 Planar systems, 9.3 Phase plane portraits.

#### WEEK 10:

Relevant practice problems: 8.1: 1,3,11,13; 8.2: 21,23,25; 8.3: 3,5; 9.1: 1,16,17; 9.2: 1,7,17; 9.3: 16,20

**Tuesday, July 18:** Quiz 6 on matrix algebra, Lecture on 8.3 Qualitative analysis, 9.1 Linear systems of constant coefficients

**Thursday, July 20:** Quiz 7 on sections 8.1,8.2,8.3,9.1,9.2,9.3. Lecture on 10.1

Nonlinear systems, 10.2 Long-term behavior of solutions

#### WEEK 11:

Relevant practice problems: 10.1: 1,2,19bc; 10.2: 1,6; 10.3: 1,2,9,10; 10.4: 1,12

**Tuesday, July 25:** Lecture on 10.3 Invariant sets and use of nullclines, 10.4 Long-term behavior of solutions to planar systems. Run through your extra credit presentation with me before Thursday.

**Thursday, July 27:** Quiz 8 on sections 10.1, 10.2, 10.3, 10.4. Extra credit presentations.

#### WEEK 12:

**Tuesday, August 1:** Review

**Thursday, August 3:** Final on all quiz topics and relevant practice problems. Usual class time and place 6-7:45pm, Alexander J. Allen Hall 103.