

Math 225

Linear Algebra and Linear Differential Equations

Instructor: Andy Manion

Office: KAP 406A

Office Hrs: MW 2:10 - 3:40 or by appointment

Contact: amanion@usc.edu

Teaching Assistants: Viktor Kleen (11am lectures), Irmak Balcik (1pm lectures)

TA Contact Info:

Viktor Kleen:

- Office – KAP 413
- Email – kleen@usc.edu
- Math Center – Mon 12-1, Thurs 12-1, Fri 4-5

Irmak Balcik:

- Office – KAP 411
- Email – balcik@usc.edu
- Math Center – Mon 10-12, Thurs 2-3

Units: 4.0

Term: Fall 2018

Day: MWF

Time: 11:00 AM (Section 39544R) or 1:00 PM (Section 39550R)

Discussion Section Time:

Section 39545R: T/Th 10:00-10:50 AM, Kaprielian Hall (KAP) 167

Section 39546R: T/Th 11:00-11:50 AM, KAP 167

Section 39551R: T/Th 10:00-10:50 AM, Taper Hall (THH) B9

Section 39552R: T/Th 11:00-11:50 AM, THH B9

Location: Social Sciences Building (SOS) B46

Course Description

Starting from the familiar high-school algebra problem of solving systems of linear equations, we will develop the conceptual and computational machinery of linear algebra and explore how this machinery is applied to the study of ordinary differential equations. The course will be divided into three main parts; in the first part, we will study systems of linear equations and introduce related matrix notation and matrix arithmetic. We will also

study determinants of matrices. In the second part, we will introduce the more conceptual framework of vector spaces and linear transformations, and see how these concepts relate to the concrete arithmetic of matrices. We will also introduce inner product spaces, eigenvalues, and eigenvectors in this part. In the third part, we will study the basics of ordinary differential equations (ODEs), focusing on (systems of) linear differential equations and highlighting the use of linear-algebraic concepts in understanding ODEs. This course description is subject to change as the semester progresses.

Learning Objectives

- Proficiency with computational algorithms such as matrix arithmetic, Gaussian elimination, computing determinants, the Gram-Schmidt process, computing eigenvalues and eigenvectors, solving certain types of linear ODEs, the exponential matrix, solving linear systems with the exponential matrix, etc.
- Fluency with the language of linear algebra and differential equations, and understanding of relevant abstract concepts, including vector spaces, linear transformations, subspaces, span / linear independence / basis, dimension, kernel / image, the rank-nullity theorem, isomorphisms, inner product spaces, eigenvalues and eigenvectors, ordinary differential equations (linear vs. nonlinear, homogeneous vs inhomogeneous, order, etc.), systems of differential equations, structure and dimension of solution spaces via fundamental theorem of ODEs, etc.

If time permits, we will attempt to achieve all these learning objectives by the end of the course.

Prerequisite(s): MATH 126 or MATH 127

Course Notes

Letter grade. Blackboard will be used for course management; your grades will be posted on Blackboard.

Math Center Information

The Math Center will be open in KAP 263, starting Week 2, Monday–Thursday 8am–7pm and Friday 8am–5pm. You can work on homework in the Math Center with your friends, and there will be graduate student TAs available to give help and answer questions. The schedule during Week 2 may be a bit intermittent, but starting Week 3 there should always be TAs present while the Math Center is open.

Technological Proficiency and Hardware/Software Required

The only technology we will use regularly in this course will be Blackboard. However, when studying differential equations, it can be useful to visualize their solutions using technology; one language for doing this is Sage <https://www.sagemath.org/>, which you can conveniently use in your browser at <https://cocalc.com/> (formerly Sage Math Cloud; this platform offers free options, which I recommend, as well as paid options). I will try to give some examples of how to use Sage to visualize solutions when we get to the differential equations part of the course, but use of Sage or any other mathematics software will not be required for the course.

IT Help

For difficulties with Blackboard, see <http://studentblackboardhelp.usc.edu/>. For questions about Sage or other mathematical software, I can try to be of use, but I'm not an expert on these programs. Many useful videos can be found online, e.g. <https://www.youtube.com/watch?v=NxydhZSS0zw>.

Required Readings and Supplementary Materials

Main textbook *Differential Equations & Linear Algebra*, Stephen W. Goode and Scott A. Annin, Pearson, fourth edition; available at the USC Bookstore. All required readings will be from this textbook.

The following reference offers an alternative perspective and is available for free online: *Linear Algebra Done Wrong* <https://www.math.brown.edu/~treil/papers/LADW/LADW.html>.

Assignments

Reading assignments from Goode–Annin will be given each week. There will also be a problem set all or most weeks.

Exams

There will be two midterm exams on Friday, September 28 and Friday, November 2 and a cumulative final exam on Wednesday, December 5 from 11am-1pm (for Section 39544R) or Wednesday, December 12 from 11am-1pm (for Section 39550R). The midterm exams will take place during the usual lecture time in the usual lecture room. The date of the final exam will be announced by the University.

No note sheets or calculators are allowed on exams.

Assessment of Assignments and Exams

All assignments and exams will be graded on correctness, completeness, clarity, and concision. Here are some additional notes on showing work, partial credit, etc:

- You are expected to show your work for all computational problems. You can do minor steps (e.g. arithmetic) in your head, but all major pieces of the computation should be shown explicitly.
- You will not be asked to write full, formal proofs in this course. However, you will sometimes be asked to (for example) explain why something is true or false; on this type of problem, you will be graded especially on how clear your logic or reasoning is.
- Similarly, you will not be asked to write only in full, complete sentences in your written work, but the more your computations are clearly laid out and explained, the better. We may take off points if it's difficult to follow your steps / reasoning, even if they're correct.
- Partial credit will be assigned in general (some exceptions may exist) based on how much of a correct solution you have, whether the ideas/computations that are present are clear or unclear, whether extraneous things are present, and whether mistakes / computational errors / conceptual errors exist in what's written.

Make-up exam policy

For exams, no excused absences will be given except in a serious emergency or for a religious observance. If a serious emergency arises (e.g. emergency room visit, death in the family, etc.), an excused absence is possible, but I will require documentation.

If a midterm or final exam conflicts with a religious observance, you need to discuss the conflict with me no later than two weeks before the scheduled exam date.

For excused absences on exams due to a serious emergency or religious observance, either makeup exams will be given or the below grading schema will be modified at the instructor's discretion, subject to departmental guidance.

Grade appeals

You should submit any questions on exam grading to me by email; I will consult with the TAs and see if any grading mistakes were made. The deadline for submitting regrade requests is *two weeks* after an exam; for a Friday exam, all regrade requests must be submitted by the end of the day two Fridays later. If you are still unsatisfied with a grading decision after I have reviewed it, there is a two-level appeals process described in <https://policy.usc.edu/scampus-part-c/>.

Grading Breakdown

Your grade will be based on your scores in the following categories:

Category	Number of Scores	% of Grade
Homework	13	20
Midterm exams	2	50 (25 each)
Final exam	1	30
TOTAL		100%

Note that while there will be 15 homework assignments, only 13 will count towards your grade. *Your lowest two homework scores will be dropped from your grade, giving you some leeway to miss assignments in emergencies.*

Assignment Submission Policy

Reading assignments should be completed by the date indicated on the assignment. Problem sets are due on Fridays in lecture starting Friday, August 24. We will try to grade and return them by the following Thursday.

Late submission of homework is not allowed; if you can't make it to lecture, you can email me your assignment in .pdf form and it will be on time if I receive it by the beginning of your assigned lecture time. Also recall that your two lowest homework scores are dropped from your grade.

Additional Policies

Laptops and tablets are allowed in class, but only for the purpose of class-related activities (e.g. taking notes; no Facebook, etc.).

Course Schedule

Time permitting, we will be spending the first 11 to 12 weeks of the semester on chapters 2 through 7 in the text and the remaining weeks on chapters 1, 8, and 9.

A weekly course schedule, with topics, reading assignments, and problem sets, will be filled in as we progress through the semester; it will be available on Blackboard.

Students with Disabilities

Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me (or to the TA) as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m.5:00 p.m., Monday through Friday.

Website for DSP: http://sait.usc.edu/academicssupport/centerprograms/dsp/home_index.html

Contact information:

- (213) 740-0776 (Phone)
- (213) 740-6948 (TDD only)
- (213) 740-8216 (FAX)
- ability@usc.edu (email)

Statement on Academic Conduct and Support Systems

Academic Conduct

Plagiarism presenting someone else's ideas as your own, either verbatim or recast in your own words is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in *SCampus* in Section 11, *Behavior Violating University Standards* <https://scampus.usc.edu/1100-behavior-violating-university-standards-and-appropriate-sanctions/>. Other forms of academic dishonesty are equally unacceptable. See additional information in *SCampus* and university policies on scientific misconduct, <http://policy.usc.edu/scientific-misconduct/>.

Discrimination, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the *Office of Equity and Diversity* <http://equity.usc.edu/> or to the *Department of Public Safety* <http://capsnet.usc.edu/department/department-public-safety/online-forms/contact-us>. This is important for the safety of the whole USC community. Another member of the university community such as a friend, classmate, advisor, or faculty member can help initiate the report, or can initiate the report on behalf of another person. The *Center for Women and Men* <http://www.usc.edu/student-affairs/cwm/> provides 24/7 confidential support, and the sexual assault resource center webpage sarc@usc.edu describes reporting options and other resources.

Support Systems

- A number of USC's schools provide support for students who need help with scholarly writing. Check with your advisor or program staff to find out more.
- Students whose primary language is not English should check with the *American Language Institute* <http://dornsife.usc.edu/ali>, which sponsors courses and workshops specifically for international students.
- If an officially declared emergency makes travel to campus infeasible, *USC Emergency Information* <http://emergency.usc.edu/> will provide safety and other updates, including ways in which instruction will be continued by means of blackboard, teleconferencing, and other technology.

- Student Counseling Services (SCS) (213) 740-7711 24/7 on call Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention. engemannshc.usc.edu/counseling
- National Suicide Prevention Lifeline 1 (800) 273-8255 Provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week. www.suicidepreventionlifeline.org
- Relationship and Sexual Violence Prevention Services (RSVP) (213) 740-4900 24/7 on call Free and confidential therapy services, workshops, and training for situations related to gender-based harm. engemannshc.usc.edu/rsvp
- Sexual Assault Resource Center For more information about how to get help or help a survivor, rights, reporting options, and additional resources, visit the website: sarc.usc.edu
- Office of Equity and Diversity (OED)/Title IX Compliance (213) 740-5086 Works with faculty, staff, visitors, applicants, and students around issues of protected class. equity.usc.edu
- Bias Assessment Response and Support Incidents of bias, hate crimes and microaggressions need to be reported allowing for appropriate investigation and response. studentaffairs.usc.edu/bias-assessment-response-support
- Student Support and Advocacy (213) 821-4710 Assists students and families in resolving complex issues adversely affecting their success as a student EX: personal, financial, and academic. studentaffairs.usc.edu/ssa
- Diversity at USC Information on events, programs and training, the Diversity Task Force (including representatives for each school), chronology, participation, and various resources for students. diversity.usc.edu
- USC Department of Public Safety UPC: (213) 740-4321 HSC: (323) 442-1000 24-hour emergency or to report a crime. Provides overall safety to USC community. dps.usc.edu