

## SYLLABUS

# Linear Algebra for Engineering

EE 510: Fall 2020 (4 units)

This course introduces you to concepts in matrix and vector theory. Engineering disciplines use linear algebra to represent complex mathematical relations in compact forms. Linear algebra also provides a convenient means to represent non-commutative operations. Every matrix defines a linear map from one vector space to another and judicious applications of these mappings often lead to impressive simplifications and new interpretations for existing results. This course begins with basic matrix operations and characterizing the behavior of maps based on their properties. The remainder of the course covers topics relevant to deeper engineering studies.

Instructor: Brandon Franzke  
Email: franzke@usc.edu  
Office: EEB 504B (remote)  
Zoom: meet: 998 5176 5591  
code: 574987  
Hours: Mo 14:00 – 15:30  
Th 10:00 – 11:30

### Lecture

Monday and Wednesday (section: 30722)  
12:00 – 13:50

### Piazza

Piazza gets you help fast and efficiently from classmates, the TAs, and me. I encourage you to post questions on Piazza rather than emailing questions to the teaching staff.

<https://piazza.com/usc/fall2020/ee510/home>

### Canvas *(replaces Blackboard)*

Use Canvas to electronically submit your homework and view course grades. You will receive an email to register during the first week of classes. Contact the instructor with any issues.

<https://canvas.usc-ece.com>

### TAs and graders

TA:	Mozhdeh Rouhsedaghat	Grader:	Howon Lee
Zoom:	meet:	Office hours:	by appointment
	code:	E-mail:	howonlee@usc.edu
Office hours:	TBD		
Email:	rougseda@usc.edu		

### Course materials

"Linear Algebra and its Applications", 4th edition, Gilbert Strang, Cengage Learning, 2006, (ISBN: 0030105676). *(required)*.

"Schaum's Outline of Linear Algebra ", 6th edition, Seymour Lipschutz and Marc Lipson, McGraw-Hill Education, 2017, (ISBN: 1260011445). *(optional)*.

## Course Outline (tentative)

week of

1	17 Aug	Introduction. Simultaneous linear equations. Decompositions. Matrix inverse.
2	24 Aug	Vector spaces and subspaces. Vector spaces over $\mathbb{R}$ . Finite fields.
3	31 Aug	Matrix subspaces. Linear transformations.
4	<b>07 Sep</b>	<b>Quiz #1 (covers weeks 1-3), 12:00 – 12:55</b>
	10 Sep	Bases. Dependence and independence. Dimension.
5	14 Sep	Orthogonality. Inner product. Orthogonalization. Projection.
6	21 Sep	Matrix determinant and applications.
7	28 Sep	Geometry in $\mathbb{R}^n$ . Scaling and rotation. Matrix norm.
8	<b>05 Oct</b>	<b>Exam #1, 12:00 – 13:30</b>
	08 Oct	Eigenvalues. Eigenvectors. Characteristic equation.
9	12 Oct	Diagonalizable matrices. Pseudoinverse Singular value decomposition. Condition number.
10	19 Oct	Special matrices: symmetric, Hermitian, positive definite, orthogonal, stochastic.
11	<b>26 Oct</b>	<b>Quiz #2 (covers weeks 8-11), 12:00 – 12:55</b>
	29 Oct	Mean square error. Optimization. Least squares.
12	02 Nov	Gradient descent optimization. Sparsity.
13	09 Nov	Linear programming. Graphs. Special applications.
	<b>04 Dec</b>	<b>Final (Exam #2), 11:00 – 13:00</b>

## Grading Procedure

### Homework

Assigned weekly. Textbook problems are checked but not graded. Homework handout problems are graded but count only as optional points. Homework counts at most as 10 points if all homework sets turned in and accurately worked. Your grade remains as is if only some homework turned in. How much homework affects which cases and is at the discretion of the instructor and the teaching assistant.

You may discuss homework problems with classmates but each student must do his or her own work. Cheating warrants an F in the course. Turning in identical homework establishes a rebuttable presumption of cheating.

### Computer Assignments

Assigned 3-4 per term. Each Python computer assignment covers specific lecture topics and may include implementation requirements and detailed analysis. The grader will score each project out of 30 points following the rubric:

- 40% Code: program correctness and documentation
- 20% Design and efficiency: description of methods and reasons why
- 40% Results: discussion, analysis, and presentation

Projects are due by the posted due date. Late projects will be accepted with a 15% deduction per day for up to 48 hours.

### Checkpoint Quizzes

Checkpoint quizzes are short (45-60 minutes) non-cumulative quizzes that cover only the most recent material. The quizzes highlight important concepts and methods. They test your conceptual understanding and application

of major principles. They occur approximately during week 4 and week 11. Ensure that you can stream live video (mute or “audio off”) during the entirety of the work time for proctoring. You must make prior arrangements with me if that is not possible. You may use a single 8.5"x11" reference sheet (front and back OK). You may not use any additional resources. You may bring a scientific (non-graphing) calculator but it is not required.

### Exams

All exams are cumulative. Ensure that you can stream live video (mute or audio off) during the entirety of the work time for proctoring. You must make prior arrangements with me if that is not possible. You may use a single 8.5"x11" reference sheet (front and back OK). You may not use any additional resources. You are expected to bring a non-graphing scientific calculator. You must show how you arrived at your answers to receive full credit. Any cheating may result in an “F” in the course and will be referred to Student Affairs for other penalties. Make up exams will only be given for valid medical or family emergency excuses (proof required).

### Course Grade

Computer HW	15%	A	if 90 – 100 points
Quizzes	20%	B	if 80 – 89 points
Exam 1	30%	C	if 70 – 79 points
Exam 2	35%	D	if 60 – 69 points
		F	if 0 – 59 points
			(“+” and “-” within approx. 2% of grade boundary)

### Attendance and Participation

Attendance is mandatory to all lectures and discussions. You are responsible for missed announcements and changes to the course schedule and assignments. Your attendance may be synchronous or asynchronous. Make synchronous attendance a priority. Per university guidance: you should plan to attend every synchronous session of this class regardless of when it occurs in your time zone. Some unreasonable hours (sessions outside 07:00 – 22:00) may preclude this general rule.

Synchronous class dynamics are improved substantially with visible participants in the class. Arrange to have your cameras on (default: “camera on, audio off”) during synchronous online sessions. You must make prior arrangements with me if that is not possible.

USC policy requires that all classes conducted online be recorded for asynchronous viewing with transcriptions made available. These recordings are considered “educational records” subject to federal privacy laws (FERPA) as students may be personally identifiable in class recordings by voice, name, or image. Students are not permitted to create their own class recordings without prior written permission. Violations of these policies will be met with the appropriate disciplinary sanction.

### Cheating

Cheating is not tolerated on homework or exams. Penalty ranges from F on exam to F in course to recommended expulsion.

## **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-andappropriate-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/contactus>. 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/studentaffairs/cwm/> provides 24/7 confidential support, and the sexual assault resource center webpage <http://sarc.usc.edu> describes reporting options and other resources.

### **Academic Integrity**

Academic integrity is critical the assessment and evaluation we perform which leads to your grade. In general, all work should be your own and any sources used should be cited. Gray-areas occur when working in groups. Telling someone how to do the problem or showing your solution is a VIOLATION. Reviewing examples from class or other sources to help a fellow classmate understand a principle is fine and encouraged. All students are expected to understand and abide by these principles. SCampus, the Student Guidebook, contains the University Student Conduct Code in Section 10, while the recommended sanctions are located in Appendix A. Students will be referred to the Office of Student Judicial Affairs and Community Standards for further review, should there be any suspicion of academic dishonesty.

## **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 graduate students. The Office of Disability Services and Programs [http://sait.usc.edu/academicssupport/centerprograms/dsp/home\\_index.html](http://sait.usc.edu/academicssupport/centerprograms/dsp/home_index.html) provides certification for students with disabilities and helps arrange the relevant accommodations. 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.

### **Academic Accommodations**

Any student requiring 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 as early in the semester as possible. DSP is located in GFS 120 and is open 08:30 – 17:00, Monday through Friday. The phone number for DSP is (213) 740-0776.