MA-110-D: Introduction to Linear Algebra - Fall 2022 Syllabus

Department of Mathematics, Albert Nerken School of Engineering
The Cooper Union for the Advancement of Science and Art

Instructor Robert Smyth, Professor, Mathematics.
See `http://faculty.cooper.edu/smyth` for office hours and contact information.

Class Hours Tuesdays 2-3:50 PM (Room 503)

Catalog Description Vectors in two- and three-dimensions, vector algebra, inner product, cross product and applications. Analytic geometry in three dimensions: lines, planes, spheres. Matrix algebra; solution of systems of linear equations, determinants, inverses, complex numbers. *2 credits. Prerequisite: none*

Textbook Howard Anton, "Elementary Linear Algebra", 10^{th} edition, Wiley (2010), ISBN-13: 978-0470458211

Course Objectives
1. Develop the basic vector algebra toolkit and use it to formulate and solve problems in $\mathbb{R}^n$.
2. Develop methods to represent and solve systems of linear equations.
3. Prove elementary results involving matrices and determinants.

Course Topics and Homework

1. Vectors in 2-space, 3-space, and n-space (3.1, H.A.: 1, 2, 3c–f, 6, 7, 9, 11, 13d, 15f, 21, 23, 24, 26 [also redo 26 using (0,3,-1) in place of (0,3,1)], 32, 33, 36e, 37b, ALL True-False exercises).

2. Norm, dot product, and distance in $\mathbb{R}^n$ (3.2, H.A.: 1a,c, 2c, 3a,b, 5a,c, 7, 9, 11a, 13a, 15, 17, 18, 20b, 22, 23c, 27, 30c, 33, 34, ALL True-False exercises).

3. Orthogonality (3.3, H.A.: 1, 3, 5–7, 9, 11, 12, 13, 14, 16, 17, 19, 21, 24, 25, 29, 31, 33, 36, 37, 41–43, 45, 46, ALL True-False exercises).

4. The geometry of linear systems (3.4, H.A.: 1, 3, 4, 6, 7, 9, 13, 15, True-False (a)–(c)).

5. Cross product (3.5, H.A.: 1, 3, 6, 7, 10, 11, 13, 15, 17, 20, 22, 25, 29–31, 34–36, 40a, ALL True-False exercises).

6. Introduction to systems of linear equations (1.1, H.A.: 1–7, 9, 11, 13, 15–17, ALL True-False exercises).

7. Gaussian elimination (1.2, H.A.: 1–3, 5, 7, 8, 9, 13–17, 19, 24–31, 33, 36, 37, 39–43, ALL True-False exercises).

8. Matrices and matrix operations (1.3, H.A.: 1, 3, 7, 10, 11, 13a, 15–17, 19, 21, 22, 24–30, ALL True-False exercises). Inverses; algebraic properties of matrices (1.4, H.A.: 1, 3, 4, 7–10, 16, 18, 24, 25, 27–30, 32, 33, 35, 50, 52, 54, ALL True-False exercises).

9. Elementary matrices and a method for finding A^{-1} (1.5, H.A.: 1–3, 5, 7, 9, 13, 20, 25–27, 29, 31, 33, 35, 37, 40–43, ALL True-False exercises).

10. More on linear systems and invertible matrices (1.6, H.A.: 2, 3, 8, 9, 15, 18, 19, 21–24, ALL True-False exercises). Diagonal, triangular, and symmetric matrices (1.7, H.A.: 2–6, 8, 10, 13–25, 27, 32–38, 42, 43, ALL True-False exercises).

11. Determinants by cofactor expansion (2.1, H.A.: 1, 3, 5, 15–17, 19, 21, 23, 26–34, 37, 38, 40, ALL True-False exercises).

12. Evaluating determinants by row reduction (2.2, H.A.: 2, 5–10, 13, 17, 18, 20–23, 28, 29, 31, 33–35, ALL True-False exercises).

13. Properties of determinants; Cramer's rule (2.3, H.A.: 1, 5, 8–10, 15–17, 20, 24, 25, 27, 30, 31, 34, 35a,d, 36, 38, 39, ALL True-False exercises).

14. Complex numbers (App. B, H.A.: See `faculty.cooper.edu/smyth/ma110/hw.htm`). Eigenvalues and eigenvectors (5.1, H.A.: 1–4 [Also find eigenvectors corresponding to any real eigenvalues in prob. 4.]).

Tutoring Tutoring is available for this course both through the Math Help Room (Rm 505, MWTh 1-2pm), and via individual tutoring. Click here for current scheduling information for one-on-one tutoring.

Assessment The term grade will be based on homework (5%), two midterms (25% each), and one cumulative final exam (45%). The exams will test your familiarity with the principles of the subject with routine problems and your ability to extrapolate creatively from these principles on challenging problems. See the section on **Grades of Record** at `cooper.edu/engineering/curriculum/academic-standards-regulations` for the letter grades used for this course and their proper interpretation. The exam schedule is posted at `http://faculty.cooper.edu/smyth/ma110/ma110.htm`.

Homework Policies You may work individually or in groups of at most three students. A group must make a single joint submission with all team members listed at the top of the front page. In the case of a group submission all members will receive the same grade for the assignment. You should make sure you understand all the solutions your team is submitting, even if other team members came up with them. Any assistance you (or your group) receives and all sources you use in preparing your homework assignments must be properly credited in writing on your submission. Groups may be re-formed on an assignment-by-assignment basis. Homework assignments must be submitted by the end of the class period on the assignment due date. (Homework submission dates are: 9/13, 9/27, 10/11, 10/25, 11/8, 11/29, and 12/13.) Each assignment includes all problems from the list above (also available at `http://faculty.cooper.edu/smyth/ma110/hw.htm`) not previously submitted up to and including those pertaining to the last section *completed* during the class meeting one week prior to the assignment due date. Credit will not be awarded for late submissions. However, your lowest homework grade will be dropped.

Exam Policies All exams are closed book / closed notebook exams. You may use a basic scientific

calculator, but no graphing or programmable calculators, computers, cellphones, books, notebooks, or other resources may be used. Bring a pencil or pen on the day of the exam. Paper will be provided. Exams are timed. Your score may be reduced if you do not stop working on your exam after time has been called. If you choose to leave the exam room during the exam period you will not be permitted to resume working on the exam after returning. Registered students must sit for the course examinations on the scheduled day and time. Failure to do so will generally result in forfeiture of the percentage credit allotted to the missed exam. Students who have medical excuses for missing an exam should contact the Dean of Students promptly. Failure to register a request for a medically excused absence in a timely manner with the Dean of Students may complicate and potentially invalidate the request. Any student requesting a medically excused absence must provide the Dean of Students with documentation from a medical provider justifying the absence. The Dean of Students will inform me when an absence is due to a valid medical issue/condition so that the absence can be considered excused. In the event of an excused absence, the student must schedule an oral makeup exam with me as soon as is possible.

ADA Accommodations

If you believe you are entitled to an accommodation through the Americans with Disabilities Act you must self-identify to the Office of the Dean of Students, and meet with me during the first week of the term to discuss arrangements for meeting your accommodation. Cooper Union has limited resources and extra time may be required for accommodation arrangement to be feasible. If you are entitled to an accommodation on exams, you must confirm exam accommodation arrangements with me (in writing) two weeks prior to *each* exam. Students will not be afforded any special accommodations retroactively, i.e., for academic work completed prior to disclosure of the disability to me. Support services for students are described `here`.