



# STEPHEN F. AUSTIN STATE UNIVERSITY

## Department of Mathematics and Statistics

### MATH 3325 – Computational Linear Algebra Course Syllabus

**Course description:** In this course you will investigate fundamental concepts of linear algebra in the concrete setting of  $\mathbb{R}^n$  and explore their application to problems arising from mathematics, applied mathematics, and other fields. Prerequisites: MATH 2314/2114 (Calculus II).

**Core Objectives (CO):**

1. **Critical Thinking** [CO 1]: to include creative thinking, innovation, inquiry, and analysis, evaluation and synthesis of information
2. **Communication Skills** [CO 2]: to include effective development, interpretation and expression of ideas through written, oral and visual communication
- Empirical and Quantitative Skills** [CO 3]: to include the manipulation and analysis of numerical data or observable facts resulting in informed conclusions

**Student Learning Outcomes (SLO):** At the end of MATH 3325, a student who has studied and learned the material should be able to:

1. Solve linear systems of equations either explicitly or numerically.
2. Demonstrate understanding of various representations of linear systems and their interpretation in an array of physical, mathematical, and applied applications.
3. Perform basic matrix calculations.
4. Explain basic linear algebra concepts (subspace, span, linear independence, basis, dimension).
5. Compute determinants of matrices.
6. Determine and approximate eigenvalues and eigenvectors of matrix or operator.
7. Diagonalize a matrix when applicable.
8. Use eigenvalue and eigenvectors to solve systems of linear dynamical systems.
9. Determine least squares solutions of linear systems.
10. Determine a generalized fourier series and coefficients explicitly and numerically.
11. Computer a singular value decomposition of a matrix.

**Credit hours:** 3

The following is an excerpt from SFA Policy 5.4:

*The federal definition of a credit hour is an amount of work represented in intended learning outcomes and verified by evidence of student achievement that is an institutionally established equivalency that reasonably approximates:*

1. *Not less than one hour of classroom or direct faculty instruction and a minimum of two hours out-of-class student work each week for approximately fifteen weeks for one semester or trimester hour of credit, or 10 to 12 weeks for one quarter hour of credit, or the equivalent amount of work over a different amount of time, or;*
2. *At least an equivalent amount of work as outlined in item 1 above for other academic activities as established by the institution including laboratory work, internships, practica, studio work, and other academic work leading to the award of credit hours.*

To this end, all students in courses offered by the Department of Mathematics and Statistics that wish to be successful should plan to spend a minimum of two hours outside of class for every credit hour associated with this course. Expected activities to be completed in the time outside of class include reviewing notes from previous class meetings, reading assigned course resources, completing all assigned exercises and projects, and performing periodic assessment preparation.

**Course Prerequisites and Corequisites:** Prerequisite of MATH 2314

**Course outline:**

- Introduction to Linear Systems (Chapter 1 & 2 in Lay)
  - Solving linear systems and the augmented problem.
  - Alternative representations of linear systems and their mathematical meaning.
  - Matrix algebra
  - Partitioned and Block matrices
  - Determinants (Chapter 3 in Lay)
  - Existence and uniqueness of solutions criteria
  - Invertible matrix theorem
- Introduction to Vector Spaces (Chapter 4 in Lay)
  - Measurement of vectors and the inner product
  - Basis for a vector space
- Eigenvalues and eigenfunctions (Chapter 5 in Lay)
  - Continuous dynamical systems
  - Discrete dynamical systems
  - Boundary value problems
- Fourier Series
  - Discrete Fourier series
  - Convergence and existence criteria
  - Fourier transform and FFT
- Least Squares, Regression, and Singular Value Decompositions
  - Revisiting the least squares approximation
  - Generalized least squares
  - Machine learning and mathematical modeling

**Academic Integrity**

Academic integrity is a responsibility of all university faculty and students. Faculty members promote academic integrity in multiple ways including instruction on the components of academic honesty, as well as abiding by university policy on penalties for cheating and plagiarism.

**Definition of Academic Dishonesty (SFA policy 4.1):**

*Academic dishonesty includes both cheating and plagiarism. Cheating includes, but is not limited to:*

- *using or attempting to use unauthorized materials on any class assignment or exam;*
- *falsifying or inventing of any information, including citations, on an assignment;*
- *helping or attempting to help other student(s) in an act of cheating or plagiarism.*

*Plagiarism is presenting the words or ideas of another person as if they were one's own. Examples of plagiarism include, but are not limited to:*

- *submitting an assignment as one's own work when it is at least partly the work of another person;*
- *submitting a work that has been purchased or otherwise obtained from the Internet or another source;*
- *incorporating the words or ideas of an author into one's paper or presentation without giving the author credit.*

*Penalties may include, but are not limited to, reprimand, no credit for the assignment or exam, resubmission of the work, make-up exam, failure of the course, or expulsion from the university.*

**Withheld Grades Semester Grades (SFA Policy 5.5)**

Ordinarily, at the discretion of the instructor of record and with the approval of the academic chair/director, a grade of WH will be assigned only if the student cannot complete the course work because of unavoidable circumstances. Students must complete the work within one calendar year from the end of the semester in which they receive a WH, or the grade automatically becomes an F. If students register for the same course in future terms the WH will automatically become an F and will be counted as a repeated course for the purpose of computing the grade point average. The circumstances precipitating the request must have occurred after the last day in which a student could withdraw from a course. Students requesting a WH must be passing the course with a

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minimum projected grade of C.

### **Students with Disabilities**

To obtain disability related accommodations, alternate formats and/or auxiliary aids, students with disabilities must contact the Office of Disability Services (ODS), Human Services Building, and Room 325, 468-3004 / 468-1004 (TDD) as early as possible in the semester. Once verified, ODS will notify the course instructor and outline the accommodation and/or auxiliary aids to be provided. Failure to request services in a timely manner may delay your accommodations. For additional information, go to <http://www.sfasu.edu/disabilityservices>.

### **Acceptable Student Behavior**

Classroom behavior should not interfere with the instructor's ability to conduct the class or the ability of other students to learn from the instructional program (see the [Student Conduct Code, policy 10.4](#)). Unacceptable or disruptive behavior will not be tolerated. Students who disrupt the learning environment may be asked to leave class and may be subject to judicial, academic or other penalties. This prohibition applies to all instructional forums, including electronic, classroom, labs, discussion groups, field trips, etc. The instructor shall have full discretion over what behavior is appropriate/inappropriate in the classroom. Students who do not attend class regularly or who perform poorly on class projects/exams may be referred to the Early Alert Program. This program provides students with recommendations for resources or other assistance that is available to help SFA students succeed.

**Student Learning Outcomes (SLO):** At the end of MTH 143, a student who has studied and learned the material should be able to:

1. Use linear functions and quadratic functions in business applications. [CO: 1,2,3]
2. Use matrices to solve systems of linear equations. [CO: 1,3]
3. Use matrices to solve linear programming problems. [CO: 1,3]
4. Use exponential functions and logarithmic functions and to solve equations using these functions. [CO: 1,2,3]
5. Solve simple interest and compound interest problems including annuities. [CO: 2,3]

*There are no specific program learning outcomes for this major addressed in this course. It is a general education core curriculum course and/or a service course.*