Math 517 – Linear Algebra
Course Syllabus

Course description: Finite dimensional vector spaces, linear transformations and matrices with emphasis on numerical aspects.

Credit hours: 3

Course Prerequisites and Corequisites: Undergraduate major in mathematics, including MTH 317

Course outline:	Approximate time spent
• **Finite Dimensional Vector Spaces**	20%

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  - Vector Spaces
  - Subspaces of Vector Spaces
  - Linear Combinations and Systems of Linear Equations
  - Linear Dependence and Linear Independence
  - Bases and Dimension
  - Maximal Linearly Independent Subsets
- **Linear Transformations and Matrices**   20%
  - Linear Transformations, Null Spaces, and Ranges
  - The Matrix Representation of a Linear Transformation
  - Composition of Linear Transformations and Matrix Multiplication
  - Invertibility and Isomorphisms
  - The Change of Coordinate Matrix
  - Dual Spaces
- **Diagonalization of Matrices**   20%
  - Eigenvalues and Eigenvectors
  - Diagonalizability
  - Matrix Limits and Markov Chains (Optional)
  - Invariant Subspaces and the Cayley-Hamilton Theorem
- **Inner Product Spaces**   20%
  - Inner Products and Norms
  - The Gram-Schmidt Orthogonalization Process and Orthogonal Complements
  - The Adjoint of a Linear Operator
  - Normal and Self-Adjoint Operators
  - Unitary and Orthogonal Operators and Their Matrices
  - Orthogonal Projections and the Spectral Theorem
  - Bilinear and Quadric Forms (Optional)
  - Einstein's Special Theory of Relativity (Optional)
  - Conditioning and the Rayleigh Quotient (Optional)
  - The Geometry of Orthogonal Operators (Optional)
- **Canonical Forms (Optional)**   20%
  - Jordan Canonical Form I
  - Jordan Canonical Form II
  - The Minimal Polynomial
  - Rational Canonical Form

Student Learning Outcomes (SLO): At the end of MTH 517, a student who has studied and learned the material should be able to:
- Work basic problems that make use of ideas covered in the course. [Math PLO: 2,4], [Stat PLO: 1,4]
- Define all of the basic terms introduced in the course. [Math PLO: 3], [Stat PLO: 1]
- Provide proofs of important theorems that were discussed in class. [Math PLO: 1,2,4]; [Stat PLO: 1]
- Write up their solutions to linear algebra problems making use of good language skills. [Math PLO: 1,5], [Stat PLO: 1,5]
- Present their solutions to problems they have solved to their classmates. [Math PLO: 1,5], [Stat PLO: 1,5]

Program Learning Outcomes (PLO):

Students graduating from SFASU with a M.S. degree and a <u>major in mathematics</u> will:

1. **[*Critical Reasoning*]** Independently apply the principles of logic in mathematics to develop and analyze conjectures and proofs. (understanding of abstract structures, development of definitions, development and proof of conjectures)
2. **[*Skills*]** Execute advanced mathematical procedures and build upon these standard procedures. (learning of new skills, applying or extending skills in new situations)
3. **[*Concepts*]** Demonstrate knowledge of core mathematical concepts. (definitions and theorems in analysis, definitions and theorems in linear or abstract algebra, definitions and theorems in theoretical statistics)
4. **[*Problem Solving*]** Demonstrate initiative in using various mathematical tools, including technology, to formulate, represent, and solve problems. (implement algorithms or definitions, discuss algorithmic proficiency, find numerical approximations)
5. **[*Communication*]** Demonstrate proficiency in communicating mathematics in a format appropriate to expected audiences. (written, visual, oral)

Program Learning Outcomes (PLO):

Students graduating from SFASU with an M.S. degree and a <u>major in statistics</u> will demonstrate:

1. A command of core probability and statistical concepts through major definitions and theorems. **[*Concepts*]**   (Probability and Statistical Inference)
4. The ability to independently apply principles of probability and statistics to model and solve new or non-standard problems. **[*Independent Thinking and Application*]** (Existing Literature Comprehension, Independent Progression, Resourcefulness)
5. Proficiency in communicating probability and statistics in a format appropriate to expected audiences. **[*Communication*]** (Written Communication, Oral Communication)

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