Math 539 - Real Variables I
Course Syllabus

Course description: A brief review of set theory is followed by a detailed study of metric spaces, normed linear spaces, and inner product spaces. Topics such as open and closed sets along with compactness and completeness are studied within the context of these spaces.

Credit hours: 3

Course Prerequisites and Corequisites: MTH 440

Course outline: This is the first part of the two part introductory course in Real Analysis. This course introduces the fundamental concepts and topics in Real Analysis. In this course we cover the topics listed below:

Topic	Approximate time spent
Elementary Set Theory	10%
○ Basic definitions and operations on sets	
○ Function image sets and preimages	
○ Equivalence relations	
Countable and Uncountable Sets	10%
○ Definitions and theorems of countable and uncountable sets	
○ Powers sets	
○ Uncountability of the real numbers	
Metric Spaces	15%
○ Definitions, theorems, and examples of metric spaces	
○ Convergence and limits in metric spaces	
○ Open, closed, and dense sets	
Complete Metric Spaces	10%
○ Definitions and examples	
○ Completion of a metric space.	
Compactness in Metric Spaces	15%
○ Definitions and examples	
○ Totally bounded sets, Heine Borel	
Vector Spaces	10%
○ Definitions and examples	
○ Subspaces	
○ Functionals	
Normed Linear Spaces	10%
○ Definitions and examples	
○ Banach space	
○ Metric induced by a norm	
○ Equivalence of norms	
Inner Product Spaces	20%
○ Definition and examples	
○ Hilbert space	
○ Orthogonality	
○ Separable Hilbert space	
○ Riesz-Fischer Theorem	
○ Orthogonal complement	
○ Parallelogram law	
○ Characterization of inner product spaces	

Student Learning Outcomes (SLO): At the end of MTH 539, a student who has studied and learned the material should be able to:

1. Define and apply basic set theoretic notions, including function image sets and preimage sets, cardinality, and countability. [MTH-PLO: 1,2,3,5], [STA-PLO: n.a.]
2. Understand and apply the basic properties and concepts of abstract metric spaces, especially complete metric spaces and convergence in metric spaces. [MTH-PLO: 1,2,3,5], [STA-PLO: n.a.]
3. Prove and apply the standard results for Banach and Hilbert spaces. [MTH-PLO: 1,2,3,5], [STA-PLO: n.a.]

Program Learning Outcomes (MTH - PLO):

Students graduating from SFASU with a M.S. degree and a major in mathematics 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)
5. **[*Communication*]** Demonstrate proficiency in communicating mathematics in a format appropriate to expected audiences. (written, visual, oral)

Date of document: 04/01/2009