KING FAHD UNIVERSITY OF PETROLEUM & MINERALS DEPARTMENT OF MATHEMATICS & STATISTICS

MATH 531: Real Analysis *(211)*

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Check Blackboard regularly for announcements

Textbook: Real Analysis by H.L. Royden and P.M. Fitzpatrick

Course Objectives:
The course is designed to introduce graduate students to measure theory. Stress will be particularly given to the Lebesgue measure, integration, and the classical L^p-spaces.

Assessment for this course is based on **homework's**, ***two major exams*** and a ***comprehensive final exam***, as described in the following table:

Activity	Weight
Homework	15 %
First Major Exam: (chapters 1-4) **TBF**	25 %
Second Major Exam: (chapters 5-6) **TBF**	*25 %*
Final Exam: (Comprehensive) As posted on the Registrar Website	35 %

*** If it is needed, evaluation Scheme can be revised.

Syllabus – A rough weekly guideline

Week # (Dates)	**Sections**	**Topics**
Week 1 (Aug 29 – Sep 02)	2.1-2.2 2.3	Introduction, Lebesgue outer Measure The σ-Algebra of Lebesgue Measurable sets
Week 2 (Sep 05 – 09)	2.4 2.5	Outer and Inner Approximation of Lebesgue Measurable Countable Additivity, Continuity, and the Borel-Cantelli Lemma

Week 3 (Sep 12 – 16)	3.1-3.2 3.3	Sums, Products, and Compositions Sequential Pointwise Limits and Simple Approximation Littlewood's Three Principles, Egoroffs Theorem, and Lusin's Theorem
Week 4 (Sep 19 – 23)	4.1 4.2	The Riemann Integral The Lebesgue Integral of a Bounded Measurable Function over a Set of Finite Measure
Week 5 (Sep 26 – 30)	4.3 4.4	The Lebesgue Integral of a Measurable Nonnegative Function The General Lebesgue Integral
Week 6 (Oct 3 – 7)	4.5 4.6	Countable Additivity and Continuity of Integration Uniform Integrability: The Vitali Convergence
Week 7 (Oct 10 – 14)	5.1 5.2	Uniform Integrability and Tightness: A General Vitali Convergence Theorem Convergence in Measure
Week 8 (Oct 17 – 21)	5.3 6.1	Characterizations of Riemann and Lebesgue Integrability Continuity of Monotone Functions
Week 9 (Oct 24 – 28)	6.2 6.3	Differentiability of Monotone Functions: Lebesgue's Theorem Functions of Bounded Variation: Jordan's Theorem
Week 10 (Oct 31 –Nov 4)	6.4 6.5	Absolutely Continuous Functions Integrating Derivatives: Differentiating Indefinite Integrals
Weeks 11 and 12 (Nov 7 – 18)	6.6 7.1	Convex Functions Normed Linear Spaces
Week 13 (Nov 21 – 25)	7.2 7.3	The Inequalities of Young, Holder, and Minkowski L^p is Complete: The Riesz-Fischer Theorem
Week 14 (Dec 05 – 09)	17.1 17.2	Measures and Measurable Sets Signed Measures: The Hahn and Jordan Decompositions
Week 15 (Dec 12 – 16)	18.1 18.2	Measurable Functions Integration of Nonnegative Measurable Functions

Outcomes:

It is expected that the student shall be able to know and use the concept of Lebesgue measure on real line, general measure theory, convergence theorems, Lusin's theorem, Egorov's theorem, L^p-spaces, Fubini's theorem, functions of bounded variation, absolutely continuous functions and Lebesgue differentiation theorem.