

**King Fahd University of Petroleum & Minerals**  
**Department of Mathematics and Statistics**  
**Semester II, 2020-21 (202)**

**Dr. Abdul Rahim Khan**

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Office Hours: Sunday, Wednesday [2 - 4 P.M.]

<b>Course</b>	Math 531
<b>Textbook</b>	Real Analysis by H.L. Royden and P.M. Fitzpatrick
<b>References</b>	1) Introduction to Lebesgue Integration by Abdul Rahim Khan 2) Measure Theory and Integration by De Barra 3) Real and Complex Analysis by W. Rudin 4) An Introduction to Measure and Integration by I.K. Rana
<b>Material</b>	Chapters 1 – 7, 17-18 of the textbook

**Objectives:** The course is designed to introduce graduate students to measure theory. In particular, the focus will be on the Lebesgue measure, Lebesgue integration, and the classical Lebesgue spaces.

Week #	Topics
1	Elementary set theory, Algebra of sets
2	The extended real numbers system, Continuous functions
3&4	<b>Lebesgue Measure</b> : Outer measure, Measurable sets, Measurable functions
5	<b>Lebesgue Integral</b> : Defects of Riemann integration
6	The Lebesgue Integral of a bounded function
7	Bounded convergence theorem, Integral of nonnegative function, Fatou's lemma,
8	Monotone convergence theorem, General Lebesgue integration, Dominated convergence theorem
9	Convergence in measure, Relation among different types of convergence modes
10	<b>Differentiation</b> : Continuity of monotone functions, Functions of bounded variation,
11	Absolute continuity, Convex functions
12&13	<b>The <math>L^p</math>-Spaces</b> : Minkowski's inequality, Holder's inequality, The Riesz-Fischer Theorem
14&15	<b>General Measures and Integration</b> : Measures and Measureable sets, Signed Measures, The integration of nonnegative measurable function, The Fubini theorem

**Outcomes:**

It is expected that the student will learn: (1) The concept of Lebesgue measure on real line and know its uses in the context of: convergence theorems, Lusin's theorem, Egorov's theorem,  $L^p$ -spaces, functions of bounded variation, absolutely continuous functions and Lebesgue differentiation theorem. (2) General measures and signed measures and their relevance to Jordan Decomposition and Fubini theorem.

**Evaluation Policy:**

Mid-Term Exam	30%
Homework (4x5)	20 %
Presentation	10 %
Final Exam(Comprehensive)	40 %

KFUPM attendance policy will be applicable.