

King Fahd University of Petroleum and Minerals  
 Department of Mathematical Sciences  
**SYLLABUS**  
 Semester II, 2017-2018 (172)  
 Dr. Monther R. Alfuraidan

**Course #:** Math 531  
**Title:** Real Analysis  
**Textbook:** Real Analysis by H.L. Royden and P.M. Fitzpatrick.  
**Additional Reading:** Real and Abstract Analysis by E. Hewitt and K. Stromberg  
**Lecturer:** **Name: Monther Alfuraidan** **Office:** 5-313 **Phone: 1977**  
**E-mail: monther@kfupm.edu.sa** (The best way to reach me)  
**Web Site: <http://faculty.kfupm.edu.sa/math/monther>**  
**Office hours:** 11:20 – 12:00PM (MW) (Other times by appointment)

**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.

Week	Date	Sec. #	Topics
1	Jan 21-25	2.1-2.2	Introduction, Lebesgue outer Measure
		2.3	The $\sigma$ -Algebra of Lebesgue Measurable sets
2	Jan 28- Feb 1	2.4	Outer and Inner Approximation of Lebesgue Measurable
		2.5	Countable Additivity, Continuity, and the Borel-Cantelli Lemma
3	Feb 04-08	3.1,3.2	Sums, Products, and Compositions Sequential Pointwise Limits and Simple Approximation
		3.3	Littlewood's Three Principles, Egoroff's Theorem, and Lusin's Theorem
4	Feb 11- 15	4.1	The Riemann Integral
		4.2	The Lebesgue Integral of a Bounded Measurable Function over a Set of Finite Measure
		4.2	Continue
5	Feb 18-22	4.3	The Lebesgue Integral of a Measurable Nonnegative Function
		4.4	The General Lebesgue Integral
6	Feb 25- Mar 01	----	Review and catch up
		<b>Exam I</b>	<b>Wednesday, Feb 28, 2018, Material (2.1-4.4)</b>
7	Mar 04-08	4.5,	Countable Additivity and Continuity of Integration
		4.6	Uniform Integrability: The Vitali Convergence
8	Mar 11-15	5.1	Uniform Integrability and Tightness: A General Vitali Convergence Theorem
		5.2	Convergence in Measure
		5.3	Characterizations of Riemann and Lebesgue Integrability
9	Mar 18-22	6.1	Continuity of Monotone Functions
		6.2	Differentiability of Monotone Functions: Lebesgue's Theorem
		6.3	Functions of Bounded Variation: Jordan's Theorem
		6.4	Absolutely Continuous Functions
10	Mar 25-29	6.5	Integrating Derivatives: Differentiating Indefinite Integrals
		6.6	Convex Functions
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11	Apr 01-05	----- Exam II	<b>Review and catch up</b> <b>Wednesday, Apr. 04, 2018, Material (4.5-6.6)</b>
12	Apr 08- 12	7.1	Normed Linear Spaces .....
		7.2	The Inequalities of Young, Holder, and Minkowski
		7.3	$L^p$ is Complete: The Riesz-Fischer Theorem
13	Apr 15-19	17.1	Measures and Measurable Sets
		17.2	Signed Measures: The Hahn and Jordan Decompositions
14	Apr 22-26	18.1	Measurable Functions
		18.2	Integration of Nonnegative Measurable Functions
15	Apr 29- May 03	-----	Review and Catch up
<b>Final Exam: TBA Material: Comprehensive</b>			

### Supplemental Instruction:

The students will find supplemental instruction material prepared by Dr Khamsi at:

<http://www.drkhamsi.com/classe/RA/> This webpage contains many exercises which deal with the content of this course. Dr Khamsi may be contacted at: Mohamed@utep.edu , if you have any question.

### 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.

### Evaluation Scheme:

Student will be evaluated and graded on the basis of:

- Two Major Exams (20 points each) 40%
- Homework 25%
- Final Exam 35%