REAL ANALYSIS – MATH 531 – TERM 182

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Office Hours Sunday – Tuesday: 3:00-3:50PM and by appointment

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Text:

Real Analysis by H.L. Royden and P.M. Fitzpatrick, 4th Ed, Pearson

Description:

- Lebesgue measure and outer measure.
- Measurable functions.
- The Lebesgue integral.
- Lebesgue convergence theorem.
- Differentiation and integration.
- L_p spaces.
- Riesz representation theorem.
- Introduction to Banach and Hilbert spaces.

Student Learning Outcomes:

After completion of the course, the students should be able to:

- Know the notion of sigma-algebra.
- Identify the Lebesgue Measurable sets and describe basic properties of the Lebesgue measure.
- Identify and perform operations on measurable functions.
- Use the Monotone Convergence Theorem, Fatou's Lemma and the Dominated Convergence Theorem.
- Compare and differentiate between the Riemann integral and the Lebesgue integral.
- Distinguish between different types of convergence.
- Identify functions of bounded variations and absolutely continuous functions.
- Define the Lp spaces and use their basic properties.
- Apply Fubini's Theorem.

Grading Policy:

- 50%: Two In-class Major Exams
- 20%: Homework
- 30%: Final (**Comprehensive**)

Resources:

- Blackboard (Course Material)
- My website for following on grades and attendance

Plagiarism and Cheating: (Please read carefully)

This course is composed of both individual as well as group assignments. It is important that your individual assignment be completed with your own efforts instead of copying it from your fellow student. KFUPM instructors follow "zero tolerance" approach with regard to cheating and plagiarism. During examinations (quizzes, major exams, lab reports) cheating or any attempt of cheating by use of illegal activities, techniques and forms of fraud will result in a grade of F in the course along with reporting the incident to the higher university administration.

Evaluation:

Final grade is according to the scale

GRADE	RANGE
A+	[90%, 100%]
A	[80%, 90%)
B+	[75%, 80%)
B	[70%, 75%)
C+	[65%, 70%)
C	[60%, 65%)
D+	[55%, 60%)
D	[50%, 55%)
F	[0%, 50%)

Course Schedule:

Week	Topic	Required Reading
1	Introduction	2.1
	Lebesgue outer Measure Absolute	2.2
	The σ-Algebra of Lebesgue Measurable sets	2.3
2	Outer and Inner Approximation of Lebesgue Measurable	2.4
	Countable Additivity, Continuity, and the Borel-Cantelli Lemma	2.5
3	Sums, Products, and Compositions	3.1
	Sequential Pointwise Limits and Simple Approximation	3.2
	Littlewood's Three Principles, Egoroff's Theorem, and Lusin's Theorem	3.3
4	The Riemann Integral	4.1
	The Lebesgue Integral of a Bounded Measurable Function over a Set of Finite Measure	4.2
5	The Lebesgue Integral of a Measurable Nonnegative Function	4.3
	The General Lebesgue Integral	4.4
6	Review for exam 1	
	Exam 1 (Tuesday)	
7	Countable Additivity and Continuity of Integration	4.5
	Uniform Integrability: The Vitali Convergence	4.6
8	Uniform Integrability and Tightness: A General Vitali Convergence Theorem	5.1
	Convergence in Measure	5.2
	Characterizations of Riemann and Lebesgue Integrability	5.3
9	Continuity of Monotone Functions	6.1
	Differentiability of Monotone Functions: Lebesgue's Theorem	6.2
	Functions of Bounded Variation: Jordan's Theorem	6.3
10	Absolutely Continuous Functions	6.4
	Integrating Derivatives: Differentiating Indefinite Integrals	6.5
11	Review for exam 2	
	Exam 2 (Tuesday)	
12	Convex Functions	6.6
	Normed Linear Spaces	7.1

Week	Topic	Required Reading
13	The Inequalities of Young, Holder, and Minkowski	7.2
	$L\ p$ is Complete: The Riesz-Fischer Theorem	7.3
14	The Riesz Representation for the Dual of L^{p}, $1 \leq p < \infty$	8.1
	Weak Sequential Convergence in L^{p}	8.2
15	Review for final exam	

FINAL EXAM - Saturday April 27, 2019 - 7:00 pm - 10:00 pm