

Syllabus: MATH 531 Real Analysis (3-0-3)

Winter 2026

Department of Mathematics

- **Instructor:** Kroumi Dhaker
- **Email:** dhaker.kroumi@kfupm.edu.sa
- **Office Hours:** By appointment & UTR 14:00–14:50
- **Lecture Times:** UTR 15:00–15:50, Building 59, Room 1017
- **Textbook:** Real Analysis by H.L. Royden and P.M. Fitzpatrick, 4-th edition.

Course 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. Product spaces, Fubini's Theorem.

Course Objectives

1. Define Lebesgue measure on the real line.
2. Explain the convergence theorems, Lusin's theorem, Egorov's theorem.
3. Discuss functions of bounded variation, absolutely continuous functions, and the Lebesgue differentiation theorem.
4. Explain the different properties of L^p spaces.
5. Define general measure theory and discuss some of its properties.
6. Discuss the permutation of integrals.

Assessment Plan

Winter 2026

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| • Homework: Three Comprehensive Homework | 20% |
| • Midterm exam: Wednesday 4 March 2026, Time 5:00 pm–7:00 pm, Local TBA | 40% |
| • Final Exam: Week 16+, Local and Time TBA | 40% |

Weekly Schedule

Week 1: Lebesgue Measure

Week 2: Lebesgue Measure (Continued)

Week 3: Lebesgue Measure (Continued)

Week 3: Lebesgue Measurable Functions

Week 5: Lebesgue Measurable Functions (Continued)

Week 6: Lebesgue Integration

Week 7: Lebesgue Integration (Continued)

Week 8: Lebesgue Integration (Continued)

Week 9: Differentiation and Integration

Week 10: Differentiation and Integration (Continued)

Week 11: L^p Spaces: Completeness and Approximation

Week 12: L^p Spaces: Completeness and Approximation (Continued)

Week 13: General Measure Spaces: Properties and Construction

Week 14: General Measure Spaces: Properties and Construction (Continued)

Week 15: Integration Over General Measure Spaces

The Study Cycle

To learn and apply mathematics you must internalise it; it should become part of you and your thinking process. **You must own the material.** This can be achieved through a conscious effort.

Learning mathematics just as learning a foreign language is a very personal experience and cannot be achieved by simply watching someone else do it.

Here is a possible way of structuring your study process:

1. Take notes!
2. After class review and rework the class notes. If you get stuck, ask me!
3. On the weekend review (rework) the class notes for the week. Solve the Problem Set. **You should devote at least six hours per week to this.** If you get stuck during the weekend, ask me on Sunday.
4. Repeat the following week.

Course Policies

Attendance: Students are expected to attend class regularly, arrive on time, and participate actively. Electronic devices should be used only for academic purposes.

Artificial Intelligence: The use of any content generation tool (such as ChatGPT) in the writing of your assignments is prohibited.

Academic Integrity: Collaboration on assignments is prohibited, each student must submit their own work. The assignment must be handwritten (either on paper or on an electronic tablet and then printed), and must be hand-delivered. Cheating will result in a failing grade and disciplinary action.