SM331H – HONORS REAL ANALYSIS I – FALL 2025

Textbook: Principles of Mathematical Analysis, 3rd ed., by Walter Rudin

Dates	Chapter	Topics
8/18, 8/19, 8/20, 8/22	1	Number systems, field axioms, the rational numbers, ordered fields.
8/25, 8/26, 8/27, 8/29	1	Supremum and infimum, completeness, the field of real numbers.
9/2, 9/3, 9/5	1, 2	Euclidean space, convexity. Cardinality
9/8, 9/9, 9/10, 9/12	2	Countable and uncountable sets. Metric spaces. Toplogy of metric spaces: open and closed sets.
9/15, 9/16, 9/17, 9/19	2	Topology of metric spaces: interior, boundary, accumulation points. The closure.
9/22, 9/23, 9/24, **9/26**	2	The relative topology. Review. **Test 1**
9/29, 9/30, 10/1, 10/3	2	Compactness. Bolzano-Weierstrass and Heine Borel theorems.
10/6, 10/7, 10/8, 10/10	2	Connectedness. Connected subsets of R. The Cantor set.
10/14, 10/15, 10/17	3	Sequences in metric spaces. Convergence.
10/20, 10/21, 10/22, 10/24	3	Subsequences, Cauchy sequences, completeness.
10/27, 10/28, 10/29, **10/31**	3	Sequential characterizations of topological notions. **Test 2**
11/3, 11/4, 11/5, 11/7	3	Sequences of real numbers. Series. Convergence criteria
11/10, 11/12, 11/14	3	Convergence criteria. Review
11/17, 11/18, 11/19, 11/21	4	Limits of functions. Continuity
11/24, 11/25	4	Global properties of continuous functions
12/1, 12/2, 12/3, 12/5	4	Extreme value theorem, intermediate value theorem

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Learning Outcomes: Upon successful completion of the course, students will be able to

1. Use the definition of the supremum and apply the Least Upper Bound Property.
2. Determine if a sequence converges or diverges using the epsilon definition.
3. Apply the epsilon definition of a Cauchy sequence, as well as completeness theorems.
4. Use subsequences in mathematical arguments, including the limit superior and limit inferior.
5. Determine if a series converges or diverges using the definition and convergence tests.
6. Apply the epsilon-delta and sequence-based definitions of continuity and uniform continuity.
7. Use the Intermediate and Extreme Value Theorems, including understanding their proofs.
8. Complete arguments concerning elementary topology: open and closed sets, interiors and closures, boundaries and/or limit points.
9. Use multiple theoretical tools to determine if a space is compact and/or connected.