# MA491: Introduction to Real Analysis

Baker University — Spring 2024

Each of the following items refers to the indicated section from the course textbook *Introduction to Real Analysis* (Fourth Edition) by Robert G. Bartle and Donald R. Sherbert.

**Exam 1: Essential Properties of Real Numbers**

| date | day | section | topic(s) |
|---|---|---|---|
| 1/29 | M | Chapter 1: Preliminaries | ∘ sets and functions<br>∘ mathematical induction<br>∘ finite and infinite sets |
| 1/31 | W | §2.1: The Algebraic and Order Properties of $\mathbb{R}$ | ∘ field operations<br>∘ (ir)rational numbers<br>∘ inequalities |
| 2/2 | F | §2.2 Absolute Value and the Real Line | ∘ absolute value<br>∘ Triangle Inequality<br>∘ neighborhoods |

| date | day | section | topic(s) |
|---|---|---|---|
| 2/5 | M | §2.3: The Completeness Property of $\mathbb{R}$ | ∘ upper and lower bounds<br>∘ suprema and infima |
| 2/7 | W | §2.4: Applications of the Supremum Property | ∘ bounded functions<br>∘ Archimedean Property<br>∘ density of $\mathbb{Q}$ in $\mathbb{R}$ |
| 2/9 | F | §2.5: Intervals | ∘ open- and closedness<br>∘ nested intervals<br>∘ uncountability of $\mathbb{R}$ |

| date | day | section | topic(s) |
|---|---|---|---|
| 2/12 | M | Exam 1 Review | |
| 2/14 | W | Exam 1 Review | Exam 1 Practice Test |
| 2/16 | F | **Exam 1** | ∘ §1.1: Sets and Functions<br>∘ §1.2: Mathematical Induction<br>∘ §1.3: Finite and Infinite Sets<br>∘ §2.1: The Algebraic and Order Properties of $\mathbb{R}$<br>∘ §2.2: Absolute Value and the Real Line<br>∘ §2.3: The Completeness Property of $\mathbb{R}$<br>∘ §2.4: Applications of the Supremum Property<br>∘ §2.5: Intervals |

**Exam 2: Sequences of Real Numbers**

| date | day | section | topic(s) |
|---|---|---|---|
| 2/19 | M | §3.1: Sequences and Their Limits | ∘ convergence of sequences<br>∘ uniqueness of limits |
| 2/21 | W | §3.2: Limit Theorems | ∘ boundedness<br>∘ Squeeze Theorem<br>∘ algebraic operations |
| 2/23 | F | §3.3: Monotone Sequences | ∘ monotonicity<br>∘ Monotone Convergence Theorem<br>∘ applications and examples |

| date | day | section | topic(s) |
|---|---|---|---|
| 2/26 | M | §3.4: The Bolzano-Weierstrass Theorem | ∘ subsequences<br>∘ Divergence Criterion<br>∘ Monotone Subsequence Th'm<br>∘ Bolzano-Weierstrass Th'm |
| 2/28 | W | §3.5: The Cauchy Criterion | ∘ Cauchy sequences<br>∘ Cauchy Convergence Criterion |
| 3/1 | F | §3.6: Properly Divergent Sequences | ∘ infinite limits<br>∘ Monotone Convergence Th'm |

| date | day | section | topic(s) |
|---|---|---|---|
| 3/4 | M | Exam 2 Review | |
| 3/6 | W | Exam 2 Review | Exam 2 Practice Test |
| 3/8 | F | **Exam 2** | ∘ §3.1: Sequences and Their Limits<br>∘ §3.2: Limit Theorems<br>∘ §3.3: Monotone Sequences<br>∘ §3.4: Subsequences and the Bolzano-Weierstrass Th'm<br>∘ §3.5: The Cauchy Criterion<br>∘ §3.6: Properly Divergent Sequences |

**Exam 3: Limits and Continuity**

| date | day | section | topic(s) |
|---|---|---|---|
| 3/11 | M | §4.1: Limits of Functions | ∘ cluster points<br>∘ uniqueness of limits<br>∘ Sequential Criterion<br>∘ Divergence Criteria |
| 3/13 | W | §4.2: Limit Theorems | ∘ algebraic operations<br>∘ Squeeze Theorem |
| 3/15 | F | §4.3: Some Extensions of the Limit Concept | ∘ one-sided limits<br>∘ infinite limits<br>∘ limits at infinity<br>∘ Comparison Theorems |

| date | day | section | topic(s) |
|---|---|---|---|
| 3/25 | M | §5.1: Continuous Functions | ◦ Sequential Criterion<br>◦ Discontinuity Criterion<br>◦ Dirichlet's function |
| 3/27 | W | §5.2: Combinations of Continuous Functions | ◦ algebraic operations<br>◦ polynomial functions<br>◦ rational functions |

| date | day | section | topic(s) |
|---|---|---|---|
| 4/1 | M | §5.3: Continuous Functions on Intervals | ◦ Boundedness Theorem<br>◦ Maximum-Minimum Theorem<br>◦ Intermediate Value Theorem<br>◦ Preservation of Intervals Th'm |
| 4/3 | W | §5.4: Uniform Continuity | ◦ nonuniform continuity<br>◦ Uniform Continuity Th'm<br>◦ Lipschitz functions<br>◦ Continuous Extension Th'm |
| 4/5 | F | §5.6: Monotone and Inverse Functions | ◦ monotonicity<br>◦ jump at a point<br>◦ Continuous Inverse Theorem |

| date | day | section | topic(s) |
|---|---|---|---|
| 4/8 | M | Exam 3 Review | |
| 4/10 | W | Exam 3 Review | Exam 3 Practice Test |
| 4/12 | F | **Exam 3** | ◦ §4.1: Limits of Functions<br>◦ §4.2: Limit Theorems<br>◦ §4.3: Some Extensions of the Limit Concept<br>◦ §5.1: Continuous Functions<br>◦ §5.2: Combinations of Continuous Functions<br>◦ §5.3: Continuous Functions on Intervals<br>◦ §5.4: Uniform Continuity<br>◦ §5.6: Monotone and Inverse Functions |

**Exam 4: Differentiability and Integrability**

| date | day | section | topic(s) |
|---|---|---|---|
| 4/15 | M | §6.1: The Derivative | ◦ differentiability<br>◦ differentiability implies continuity<br>◦ algebraic operations<br>◦ Carathéodory's Theorem<br>◦ Chain Rule |
| 4/17 | W | *Scholars Symposium* | |
| 4/19 | F | §6.2: The Mean Value Theorem | ◦ Interior Extremum Theorem<br>◦ Rolle's Theorem<br>◦ First Derivative Test<br>◦ Darboux's Theorem |

| date | day | section | topic(s) |
|---|---|---|---|
| 4/22 | M | §6.3: L'Hôpital's Rule | ◦ indeterminate form<br>◦ Cauchy Mean Value Theorem |
| 4/24 | W | §7.1: Riemann Integral | ◦ (tagged) partitions<br>◦ norm of a partition<br>◦ Riemann sum<br>◦ Riemann integrability<br>◦ uniqueness of Riemann integrals<br>◦ Boundedness Theorem |
| 4/26 | F | §7.2: Riemann Integrable Functions | ◦ Cauchy Criterion<br>◦ Squeeze Theorem<br>◦ continuity<br>◦ monotonicity<br>◦ additivity of Riemann integrals |

| date | day | section | topic(s) |
|---|---|---|---|
| 4/29 | M | §7.3: The Fundamental Theorem | ◦ Substitution Theorem<br>◦ Composition Theorem<br>◦ Product Theorem<br>◦ integration by parts |
| 5/1 | W | Exam 4 Review | |
| 5/3 | F | **Exam 4** | ◦ §6.1: The Derivative<br>◦ §6.2: The Mean Value Theorem<br>◦ §6.3: L'Hôpital's Rule<br>◦ §7.1: Riemann Integral<br>◦ §7.2: Riemann Integrable Functions<br>◦ §7.3: The Fundamental Theorem |

| date | day | section | topic(s) |
|---|---|---|---|
| 5/6 | M | Final Exam Review | |
| 5/8 | W | Final Exam Review | |
| 5/10 | F | Final Exam Review | Final Exam Practice Test |

Our **final exam** will be held Friday, May 17 from 1:00 PM to 4:00 PM in Mulvane 401.