Syllabus for the Applied Mathematics qualifying exam in Modeling and Analysis

The exam in Modeling and Analysis constitutes one half of the qualifying exam in Applied Mathematics. The students successfully passing this test should demonstrate proficiency in basic concepts of mathematical analysis, mathematical modeling, and the use of mathematical tools to model and solve real world problems. **The emphasis in the exam is on mathematical modeling**.

Topics in Modeling:

- Compartment models, discrete time models (Calvetti and Somersalo: Chapter 2; Segel and Edelstein-Keshet: Section 2; de Vires et al: Chapters 2)
- Differential equation models (Calvetti and Somersalo: Chapter 3; de Vries et al: Chapter 3, selectively Chapter 4; Segel and Edelstein-Keshet: Section 2)
- Model scaling and similarity (Calvetti and Somersalo: Chapter 4; Segel and Edelstein-Keshet: Chapter 4)
- Stochastic modeling: Probability, distributions, sampling (Calvetti and Somersalo: Chapters 5 and 7 ; de Vries et al: Chapter 5)
- Markov models (Calvetti and Somersalo: Chapter 8)
- Agent based modeling, cellular automata (Calvetti and Somersalo: Chapter 9; de Vires et al: Chapter 6)

Topics in Analysis:

- Sequences, series, and limits (Rudin: Chapter 3; Bartle and Sherbert: Chapters 3, 4 and 9)
- Real functions: Limits, Continuity (Rudin: Chapter 4; Bartle and Sherbert: Chapter 5)
- Differentiation: Derivatives, differentials, linearization, Taylor series (Rudin: Chapter 5, selectively from Chapter 9, in particular differentiation of functions of several variables, inverse and implicit function theorems; Bartle and Sherbert: Chapter 6)
- Integration: Riemann and Lebesgue integrals (Rudin: Chapter 6, selectively from Chapter 11, in particular Lebesgue integral; Bartle and Sherbert: Chapter 7, selectively from Chapter 10, in particular improper and Lebesgue integrals)

Literature:

1. Bartle RG and Sherbert DR*: Introduction to Real analysis (3rd ed.)* , John Wiley & Sons
2. Calvetti D and Somersalo E*: Introduction to Computational Modeling*, SIAM 2012, Philadelphia
3. de Vries G, Hillen T, Lewis MA, Muller J and Schonfisch B : *Course in Mathematical Biology*, SIAM 2006,Philadelphia.
4. Rudin W: *Principles of Mathematical Analysis (3rd ed.)* . McGraw Hill
5. Segel LA and L Edelstein-Keshet L: A primer on Mathematical Models in Biology. SIAM 2013, Philadelphia