

## Advanced Calculus

### Review for Exam 3

#### Chapter 4.

- Definition of the derivative.
- Differentiability implies continuity.
- Chain rule (**with proof**).
- Derivative of a sum and a product.
- Basic derivatives (**with proofs**):  $(e^x)'$ ,  $(\log x)'$ ,  $(x^a)'$ ,  $(\sin x)'$ ,  $(\cos x)'$ .
- Rolle's theorem (**with proof**).
- Mean value theorem.
- Using mean value theorem to prove inequalities.
- L'Hopital's Rule.
- Inverse function of a monotone function.
- Inverse function theorem (**with proof**).

#### Chapter 5.

- Upper and lower Riemann sums.
- Integrable functions and the definition of the integral.
- Integrability of continuous functions (**with proof**).
- Riemann sums.
- Dirichlet function.
- Properties of the Riemann integral.
- Comparison theorem.
- Integrability of the absolute value of a function.
- Integrability of the square of a function and the product of two integrable functions (**with proof**).
- Continuity of the function  $F(x) = \int_a^x f(t) dt$  (**with proof**).
- Mean value theorem.
- Fundamental Theorem of Calculus (**with proof**).
- Integration by parts.
- Change of variables.