

### Section 1.1: Review of Calculus

- Know and be able to apply the definitions of a limit, continuity, the derivative, and the Riemann integral.
- Know the statements of the Intermediate Value Theorem, Rolle's Theorem, the Mean Value Theorem, and the Extreme Value Theorem.
- Be able to construct the Taylor Series for given function. Also know how to use Taylor's Theorem to compute an upper bound for the error when using a Taylor Polynomial to approximate the value of a function.

### Section 1.2: Round-off Errors and Computer Arithmetic

- Understand the idea of computational error and how it arises within a computational device.
- Understand and be able to carry out rounding, chopping, and  $k$ -digit arithmetic.
- Understand and be able to compute the absolute error and the relative error of an approximation.
- Understand the error bound necessary for an approximation to be good to within  $d$  significant digits.
- Understand that changing the form of an expression can impact the computational error when evaluating the expression.
- Be able to put a polynomial into nested form. Also be able to compare the computational effectiveness of equivalent forms of an expression.

### Section 1.3: Algorithms and Convergence

- Understand the definition of an algorithm and be able to interpret and produce pseudocode for a simple algorithm.
- Understand what it means for an algorithm to be stable, conditionally stable, and unstable.
- Understand the difference between linear and exponential error growth.
- Understand the definition of the rate of convergence of a limit or sequence. Also be able to find the rate of convergence for a given limit or sequence.

### Section 2.1: The Bisection Method

- Know the Algorithm for the Bisection Method, the hypotheses necessary in order to apply this algorithm, and be able to apply it to find a root of a function.
- Understand the proof that the Bisection Method converges and know the order of convergence for this algorithm.
- Be able to find an upper bound on the number of iterations necessary in order to find an approximation of a root to within a given error tolerance.

### Section 2.2: Fixed Point Iteration

- Know the Algorithm for Fixed Point Iteration, the hypotheses necessary in order to apply this algorithm, and be able to apply it to find a root of a function.
- Understand the proof that Fixed Point Iteration converges and know the order of convergence for this algorithm.
- Be able to find an upper bound on the number of iterations necessary in order to find an approximation of a root to within a given error tolerance.
- Given a function  $f(x)$  that you want to find a root for, be able to find related function(s) to which Fixed Point iteration can be applied.
- Be able to determine whether a function on a given interval satisfies the hypotheses for the Fixed Point Iteration Algorithm. Also be able to find an interval that satisfies the hypotheses, and be able to find a constant  $k$  such that  $|g'(x)| \leq k < 1$  on the interval.

### Section 2.3: Newton's Method

- Know the Algorithm for Newton's Method, the hypotheses necessary in order to apply this algorithm, and be able to apply it to find a root of a function.
- Understand the proof that Newton's Method converges.
- Know the Algorithm for Secant Method, the hypotheses necessary in order to apply this algorithm, and be able to apply it to find a root of a function.
- Know the Algorithm for the Method of False Position, the hypotheses necessary in order to apply this algorithm, and be able to apply it to find a root of a function.
- Be able to compare the computational effectiveness of these three algorithms when used to approximate a root of a specific function.