

## Study guide for Midterm 01

Review the study guides for quiz 01-quiz 03. They are all relevant for midterm 01.

1. Section 2.2: Review Limit laws, technique of rationalizing numerator or denominator to find the limit of the form  $\frac{0}{0}$ . Review statement and applications of Sandwich Theorem. Keep in mind typical examples of ' $\lim_{x \rightarrow c} f(x)$  does not exist'.
2. Section 2.3: Memorize the precise definition of  $\lim_{x \rightarrow c} f(x) = L$  using  $\varepsilon$  and  $\delta$ . Study how to prove  $\lim_{x \rightarrow c} f(x) = L$  using standard tricks such as the  $\varepsilon/2$  argument.
3. Section 2.4: Study the precise definitions of one-sided limit. Practice on variants of  $\lim_{\theta \rightarrow 0} \frac{\sin \theta}{\theta}$ .
4. Section 2.5: Study the precise definitions of continuity in terms of  $\varepsilon$  and  $\delta$ . Study the proof of Theorem 9, composition of continuous functions (in Lecture 4) and Theorem 10, limits of continuous functions (in textbook). Study the Intermediate Value Theorem and its applications including root locating.
5. Section 2.6: Study definition of the limits in p119, p125, p131 and problem 6, homework 04. Find an example for each and for practice proving with these definitions.
6. Section 3.2: Study the definition of derivative, one-sided derivatives, and relation between differentiability and continuity (Theorem 1 and proof).
7. Section 3.3: Study derivative product rule, derivative quotient rule and applications such as
 
$$\frac{d^n}{dx^n}(f(x)g(x)) = ?, \quad \frac{d}{dx}(f_1(x)f_2(x) \cdots f_n(x)) = ?$$
 and derivative of determinants, etc.
8. Section 3.5: Review the definitions and algebraic identities of trigonometric functions listed in page 1-2 of Lecture 07. Study the derivation of  $\frac{d}{dx} \sin x$ ,  $\frac{d}{dx} \cos x$  and memorize the derivatives of all six trigonometric functions.
9. Section 3.6: Practice on derivative of composite functions:  $\frac{d}{dx} f_1(f_2(\cdots f_n(x)))$  where the functions  $f_1, f_2, \cdots, f_n$  are elementary functions such as polynomials, trigonometric functions, exponential functions or their combinations.
10. Section 3.7: Study how to find derivative of a function through implicit differentiation. Also study higher order derivatives. In other words, how to find  $\frac{d^n}{dx^n} f(x)$ , when the function  $y = f(x)$  is defined implicitly through  $\{(x, y) | F(x, y) = 0\}$  with a given function  $F$ .
11. Section 3.8: Study how to derive for derivative of inverse functions. Memorize the result. Practice the trick of writing  $x = e^{\ln x}$  in various applications.