

## Study guide for Midterm 02

1. Section 3.9: Memorize the domains and ranges of all six inverse trigonometric functions. Study how to derive the derivatives of inverse trigonometric functions. Pay attention to the  $|x|$  factor in the derivatives of  $\sec^{-1}$  and  $\csc^{-1}$ .
2. Section 3.11: Study how to find approximate value of functions using linear approximation (linearization) such as  $(1+x)^k$  and  $(a+x)^k$ ,  $a > 0$ , etc. and how to estimate the error of the linear approximation (memorize the error formula in problem 3 of Homework week 08).
3. Section 3.11: Study the equivalence relation on page 7 (and the derivation on page 5-6) of Lecture 12 note (corresponding to page 222-223 of the textbook) and its application in the proof of the Chain Rule.
4. Chap 3: Review how to compute  $f'(0)$  and  $\lim_{x \rightarrow 0} f'(x)$  correctly for the function

$$f(x) = \begin{cases} x^2 \sin\left(\frac{1}{x}\right), & x \neq 0, \\ 0, & x = 0. \end{cases}$$

5. Section 4.2: Classify possible locations of local or global minimum or maximum for a continuous function on a closed interval.
6. Section 4.2: Study the statements, proofs and applications of Rolle's Theorem and Mean Value Theorem. Be careful about the difference between Intermediate Value Theorem and Mean Value Theorem.
7. Section 4.3: Study how to determine whether a critical point is a local minimum, local maximum, or neither using the first derivative test.
8. Section 4.4: Review procedures for sketching a curve, such as how to determine whether the curve is increasing/decreasing and concave up/down, how to find local extremes and points reflection, etc.
9. Section 4.5: Review how to determine a indeterminate form using L'Hôpital's Rule. Go through all examples in section 4.5. Find one example to each of the form  $\infty - \infty$ ,  $0 \cdot \infty$ ,  $1^\infty$ ,  $0^0$ ,  $\infty^0$  and study how to find the limit by L'Hôpital's Rule.
10. Section 4.5: Find an example of the form  $\frac{0}{0}$  that L'Hôpital's Rule does not lead to an answer, but after rewriting  $\frac{0}{0} = \frac{\frac{1}{0}}{\frac{1}{0}} = \frac{\infty}{\infty}$  (or vice versa), L'Hôpital's Rule can be applied to find the limit.
11. Section 4.6: Review standard procedure for applied optimization: determine relevant range of the unknown, find possible locations of maximum/minimum, and how to verify a candidate point is actually a maximum/minimum. Review all the examples in class and in problems 12, 27, 67(a).

12. Section 4.8: Understand the meaning of Antiderivatives and how to find them in simple cases. Study how to solve initial value problems using antiderivatives and how to find the undetermined constants in the antiderivative from the initial values.
13. Section 5.2, 5.3: Read and understand the meaning of a Riemann sum and pay attention to the uniform partition case ( $\Delta x_k = \Delta x = \frac{b-a}{n}$ ). Practice how to express a definite integral as the limit of Riemann sum and conversely, practice how to identify a limit of Riemann sum as a definite integral.
14. Section 5.4: Study the statement and proof of Fundamental Theorem of Calculus in both Part 1 and Part 2. Try to apply them by making up some examples to both by yourself. In particular, how to find a definite integral from antiderivative of the integrand.
15. Section 5.5, 5.6: Practice definite and indefinite integrals using substitution method. Try to make up some examples. Understand the true meaning of ' $\frac{du}{dx}dx = du$ ' and how to actually use it.