Math 1431 Fall 2017: Exam 2 Review
Professor William Ott

Exam 2 will cover the material in Sections 3.5–3.6, 3.8–3.9, 4.1–4.5, and 4.7–4.8 of *Calculus: Early Transcendentals* (Edition 8E) by James Stewart. Possible exercise types include true/false questions, statements of definitions and major results, computational exercises, and exercises requiring theoretical arguments. At least one of the exercises from Section 5 and at least one of the theoretical arguments in Section 4 will appear on Exam 2.

1. Definitions/Models

You should be able to define and use the following.

(1) Derivative of a function f at a point a; differentiable function on an interval
(2) Differential equations for exponential growth/decay, Newton's law of cooling
(3) Global maximum value of a function, global minimum value, local minimum value, local maximum value
(4) Critical point
(5) Concave up (or down) function on an interval
(6) Inflection point

2. Computational techniques

(1) Compute two-sided limits and one-sided limits
(2) Find the vertical asymptotes of a function
(3) Use the intermediate value theorem to show that a given continuous function has a root on a certain interval
(4) Compute limits at infinity
(5) Find the horizontal asymptotes of a function
(6) Compute the tangent line to a curve at a point on the curve
(7) Computation of derivatives using the limit definition
(8) Interpretation of the derivative as an instantaneous rate of change (If $s(t)$ gives position at time t, then $s'(t) = v(t)$ gives velocity at time t and $s''(t) = v'(t) = a(t)$ gives acceleration at time t.)
(9) Computation of higher derivatives
(10) Compute derivatives using the differentiation rules (power rule, sum rule, difference rule, constant multiple rule, product rule, quotient rule, chain rule)
(11) Differentiation of exponential functions, logarithms, and trigonometric functions
(12) Implicit differentiation
(13) Differentiation of inverse trigonometric functions
(14) Logarithmic differentiation
(15) Solve problems involving exponential growth/decay and Newton's law of cooling
(16) Related rates
(17) Find the global maximum and global minimum values of a continuous function f defined on a closed interval $[a, b]$
(18) Relate behavior of f' and f'' to behavior of f (increasing/decreasing test, concavity test)
(19) First derivative test, second derivative test
(20) First/second derivative analysis for a function f; curve sketching
(21) L'Hospital's rule
(22) Optimization
(23) Newton's method

3. Theoretical results

You should know and be able to apply the following.

(1) $\lim_{x\to a} f(x) = L$ if and only if $\lim_{x\to a^+} = \lim_{x\to a^-} = L$. In other words, the overall limit exists if and only if the two one-sided limits exist and are equal. This result can be used to show that a given limit exists or that a given limit does not exist.

(2) Squeeze theorem

(3) Intermediate value theorem

(4) If f is differentiable at a, then f is continuous at a. The converse is false.

(5) Extreme value theorem

(6) Fermat's theorem (page 279)

(7) Rolle's theorem, mean value theorem

(8) If $f'(x) = 0$ for all x in (a, b), then f is constant on (a, b).

4. Proofs

(1) Derive Newton's method

(2) Show that if $f'(x) < 0$ for all x in (a, b), then f is strictly decreasing on (a, b).

(3) Compute the derivative of $\sin^{-1}(x)$ or $\tan^{-1}(x)$.

5. Suggested problems

Study Assignments 5–7. Focus on exercises that are not too computationally involved and that are at most moderately difficult.