

Final Exam Review

MATH 251.03(04), CALCULUS I, FALL 2013

1. **Functions** – determine Domain and Range of a function from the formula of $f(x)$ or from a graph.
2. **Limits** – determine limits from graphs, calculate limit using limit laws, calculate limits at infinity (horizontal asymptotes), squeeze theorem.
3. **Continuity** – understand what it means for a function to be continuous, intermediate value theorem

4. Differential Calculus

(a) Definition of the derivative – finding the derivative from the definition.

(b) *Rules of differentiation:*

i. *Power Rule:* $\frac{d}{dx}(x^n) = nx^{n-1}$ for any real number n .

ii. *Product Rule:* $\frac{d}{dx}(fg) = f'g + g'f$.

iii. *Quotient Rule:* $\frac{d}{dx}\left(\frac{f}{g}\right) = \frac{gf' - g'f}{g^2}$.

iv. Derivatives of basic trigonometric functions

v. Limits involving trigonometric functions: $\lim_{\theta \rightarrow 0} \frac{\sin \theta}{\theta} = 1$

vi. *Chain Rule:* $\frac{d}{dx}(f(g(x))) = f'(g(x)) \cdot g'(x)$.

vii. Implicit differentiation

viii. Logarithmic differentiation

(c) Applications of derivatives – Understand the derivative as a rate of change, velocity function as a derivative of the displacement function, acceleration function as a derivative of the velocity function.

(d) Derivatives of Logarithmic functions.

(e) Related Rates

(f) Linear Approximations - understand the use of the tangent line in estimating function values near the point of the tangent line.

(g) Maxima and minima of functions.

(h) Curve sketching – local maxima/minima, second derivative test, determine concavity from second derivative information.

(i) Indeterminate forms and *L'Hopital's Rule*

(j) Optimization problems

5. Integral Calculus

(a) Antiderivatives - rules for basic functions

- (b) The area problem - estimate the area under the curve of $y = f(x)$ using *Riemann Sums*.
- (c) Recognize that the area under a curve from a point $x = a$ to $x = b$ is the definite integral $\int_a^b f(x) dx$.
- (d) Evaluate integrals – understand the distinction between definite and indefinite integrals.
- (e) Fundamental Theorem of Calculus (FTC) – Suppose f is a continuous function on $[a, b]$ then:
 - i. Part I - If we define $g(x) = \int_a^x f(t) dt$ then $g'(x) = f(x)$.
 - ii. Part II - $\int_a^b f(x) dx = F(b) - F(a)$, F is the antiderivative of f .
- (f) Substitution rule.