Course Overview-Math 111

- **Limits:**
  - **Idea:** $\lim_{x \to a} f(x) = L$ means $f(x)$ gets close to L as x gets close to a.
  - **Rigor:** ($\varepsilon - \delta$ definition of a limit) For every $\epsilon > 0$, there exists a $\delta > 0$ such that for every x with $0 < |x - a| < \delta$, we get $|f(x) - L| < \epsilon$.
  - **Computation:** Limit Laws, etc.
    - direct substitution
    - factoring
    - conjugate trick with square roots
    - common denominator
    - absolute value
    - infinite limits
    - right- or left-handed limits
    - limits at $\pm\infty$
  - **Uses:** All of Calculus

- **Derivatives:**
  - **Idea:** $f'(x)$ = slope of the tangent line at $(x, f(x))$
  - **Rigor:** (Limit definition) $f'(x) = \lim_{h \to 0} \dfrac{f(x+h) - f(x)}{h}$
  - **Computation:** Differentiation Rules: Product, Quotient, Chain Rules, etc.
  - **Uses:** Tangent Lines, Related Rates, Max-Min, Optimization, Graphing, etc.

- **Integrals:**
  - **Idea:** $\int_a^b f(x)\ dx$ is signed area under the curve.
  - **Rigor:** (Limit definition) $\int_a^b f(x)\ dx = \lim_{n \to \infty} \sum_{i=1}^{n} f(x_i)\Delta x$ using Riemann Sums
  - **Computation:** Fundamental Theorem of Calculus (antiderivatives $\int f(x)\ dx$), algebra combined with basic antidifferentiation rules, integration by substitution (with more techniques coming in Math 121)
  - **Uses:** Areas, Volumes, Position-Velocity Problem (rectilinear motion)

- **Special Functions:** Trigonometry, e^x, or $\ln x$. Know graphs, derivatives (and where possible the antiderivatives), and properties.