Eligible Topics for the Kossack Exam

Last updated: March 2024

Calculus I Topics

- **Limits**
  - Limit of a function, understood graphically and conceptually
  - Limit laws and continuity
  - Squeeze Theorem (aka Sandwich Theorem)
  - Intermediate Value and Extreme Value Theorems
  - Limits involving infinity: horizontal and vertical asymptotes
  - Indeterminate forms: $0/0$, ∞/∞, etc.
  - L'Hôpital's Rule
  - More advanced indeterminate forms: $0 \cdot \infty$, $\infty - \infty$, 1^{∞}, etc.

- **Derivatives**
  - Definition of derivative (using limit of difference quotient)
  - Tangent lines to a curve
  - Differentiability
  - Derivative Rules
  - Implicit differentiation
  - Derivatives of inverse functions (including $\ln(x)$ and inverse trig)

- **Derivative applications and theorems**
  - Derivatives as Rates of Change (especially velocity and acceleration)
  - Related Rates
  - Linear estimation: Linearization, differentials
  - Mean Value Theorem
  - How signs of the first and second derivative affect a function
  - Absolute and Local Extreme Values (critical points)
  - Concavity and Inflection Points
  - First and Second Derivative Tests (for local extrema)
  - Applied Optimization

- **Fundamentals of Integration**
  - Indefinite integrals and antiderivatives
  - Area (signed or total) enclosed by a curve, estimated by rectangle sums
  - Definite integral as a limit of Riemann sums
  - Properties of the definite integral, like $\int_a^c f(x)\,dx = \int_a^b f(x)\,dx + \int_b^c f(x)\,dx$
  - Fundamental Theorem of Calculus (both parts)
  - Substitution

Calculus II Topics (No Sequences, Series, or anything further)

- **Applications of Integrals**
  - Area enclosed by two curves
  - Volume of solids by integrating cross-sectional area
  - Volume of solids of revolution (disks, washers, shells)
  - Arclength and surface area (of revolution) integrals
  - Separable differential equations

- **Integration Techniques**
  - Integration by Parts
  - Integration of Trigonometric Powers
  - Trigonometric Substitution
  - Integration by Partial Fractions (includes long division)
  - Improper Integrals