Topics in 18.01

Derivatives, basic functions

Derivative as limit and linear approximation.
Polynomials. Binomial theorem. Derivatives of polynomials. Extrema.
Differentiation rules: product, quotient rule, chain rule.
Trigonometric functions and their derivatives.
Exponential, logarithm and their derivatives. Growth and decay.
Polar coordinates.
Parametrized curves.
Implicit differentiation.
First-order ODEs. Separation of variables.

Higher derivatives

Second derivative. Quadratic approximation. Local min/max. Convexity.
Examples of quadratic approximation.
Newtonian motion. Harmonic oscillator.
Higher derivatives.
Taylor approximation.

Limits and series

Limits. Continuous functions. Intermediate value theorem.
L'Hopital's rule. One-sided limits. Improper limits.
Exponential, polynomial, logarithmic growth. Piecewise defined functions.
Infinite series. Convergence tests.
Taylor series. Power series. Radius of convergence.

Integration

Definite integral. Fundamental theorem of calculus.
Indefinite integral.
Integration techniques: integration by parts and by substitution.
Rational functions. Partial fractions.
Some trigonometric integrals.
Integrals in geometry (areas, volumes, arclengths).
Integrals in physics (densities, work).
Numerical integration.
Improper integrals.
Probability. Discrete probability and continuous distributions.
Some common distributions: e.g. normal, exponential, poisson, gamma.
Mean and standard deviation.