Math 250A
Integration

Chapters 6, 7, and 8 are concerned with integration and its applications. Chapter 6 (the Fundamental Theorem of Calculus) and Chapter 7 (Techniques of Integration) are fairly theoretical, and provide somewhat less of an opportunity to take advantage of examples from biochemistry. The treatment of chapter 8 in this new version of 250A, by contrast, will likely be quite different from the existing version, which uses examples from physics and engineering as the basis of most of the applications of the integral.

The rough syllabus for this portion of Math 250A is as follows:

Fundamental Theorem of Calculus (Chapter 6)

- Review of fundamental theorem, and its use in computing integrals
- Functions without an elementary antiderivative
- Defining new functions via integrals, e.g. $\ln(x)$ and $\mathrm{erf}(x)$ (an important example later in probability)

Techniques of Integration (Sections 7.1 – 7.4)

- Integration by substitution
- Integration by parts
- Algebraic identities: partial fractions and trigonometric substitution
- Using an integral table

Numerical Integration (Sections 7.5 and 7.6)

- Left, Right, Trapezoid, Midpoint, and Simpson's rules
- Geometry of functions and overestimates vs. underestimates
- Propagation of error and rate of convergence, with a view toward numerical solutions of ODE's

Improper Integrals (Sections 7.7 and 7.8)

- Convergence and divergence of improper integrals
- Comparison of improper integrals, and error estimation in approximating convergent improper integrals
- Examples from probability

Applications of the Integral to Geometry (Sections 8.1 – 8.3)

- Area, volume, arc length, and surface area
- Allometry and dimensionality; how size scales depending on dimension
- Polar coordinates and parametric curves; archimedean spirals and applications to biology

Applications of the Integral to Biochemistry

- Density and center of mass (with examples from probability)
- Examples from biochemistry: energy? pressure?