Syllabus for Math 20C
Using Rogawski's *Calculus, Early Transcendentals*
(revised March 2008[1])

Math 20C is the third quarter course in calculus for students majoring in Mathematics, Engineering and the sciences. Most students taking Math 20C will be continuing from Math 20B, but some new freshmen are placed directly into Math 20C with Advanced Placement credit. This makes teaching Math 20C in a Fall quarter interesting: it will have both incoming freshmen with Advanced Placement credit and continuing sophomores who failed (or did not take) Math 20C the previous Spring quarter.

Math 20C introduces vectors and three-dimensional geometry and covers multivariable differential calculus with an introduction to multiple integrals. Experience has shown that students have more trouble visualizing the geometry of space and understanding the geometrical significance of the calculus than they do with the actual computations. Thus, more emphasis should be placed on *what* is being computed and *why* it is being computed than on how to compute it.

The following syllabus requires 26 lectures of the 28 to 30 lectures available in a typical quarter. Some topics can expanded if time permits, or additional topics such as Kepler's laws (Sec. 13.6) can be added.

Lec. 1 – 2. Sec. 12.1 – 12.2: Vectors: Parametric equations for a line are introduced in the context of three-dimensional vectors (12.2).

Lec. 3. Sec. 12.3: The dot product: Include projections and components.

Lec. 4. Sec. 12.4: The cross product

Lec. 5. Sec. 12.5: Planes in three-space: Students should be able to *use* the equations to solve geometric problems such as finding intersection points of lines and planes, not just write the equation given the necessary data.

Lec. 6. Sec. 11.1 & 13.1: Parametric equations & Vector-valued functions: Students should be familiar with both parametric and vector-valued representations.

Lec. 7. Sec. 13.2: Calculus of vector-valued functions: In addition to understanding that calculus on vector-valued functions is performed component-wise, students should understand the geometry of the derivative; specifically, they should understand that the derivative represents a tangent vector to the parameterized curve.

Lec. 8. Sec. 11.2 & 13.3: Arclength and speed: Briefly introduce arclength as the integral of speed, but skip the discussion of surface area (11.2) and arclength parameterization (13.3).

[1] Revised 1/2/08 – John Eggers

Lec. 9. Sec. 13.5: Motion in three-space: Discuss velocity, speed and acceleration of paths in three-space (13.5). The discussion of tangential and normal components of acceleration ("Understanding the Acceleration Vector") may be omitted if time is short.

Lec. 10. Sec. 14.1: Functions of two or more variables: Be sure students understand level curves. Some examples of surfaces from Sec. 12.6 can be included.

Lec. 11. Sec. 14.2: Limits and continuity in several variables: Keep this informal; the epsilon-delta definition was not covered in Math 20A. Aim for intuitive understanding.

Lec. 12. Sec. 14.3: Partial derivatives

Lec. 13. Sec. 14.4: Differentiability, linear approximation and tangent planes: Students should understand the connection between tangent planes and linear approximation and that differentiability is more than just existence of partial derivatives.

Lec. 14. Sec. 14.5: The gradient and directional derivatives: Students should understand the geometric significance of the gradient and not just the formal computational definition.

Lec. 15. Sec. 14.6: The chain rule: Omit the section on implicit differentiation.

Lec. 16. Sec. 14.7: Optimization in several variables: The proof of the second derivative test is optional.

Lec. 17. Sec. 14.8: Lagrange multipliers: The example with multiple constraints is optional.

Lec. 19 – 20. Sec. 15.1: Integration in several variables: Stress that the equality of double integrals with iterated integrals is a *theorem*, not the definition.

Lec. 21. Sec. 15.2: Double integrals over more general regions: Illustrate how regions can be described in two ways with a well-chosen example of changing the order of integration.

Lec. 22. Sec. 15.3: Triple integrals: Emphasize that triple integrals are just the natural extension of double integrals.

Lec. 23. Sec. 12.7: Cylindrical and spherical coordinates: This may take less than a full lecture.

Lec. 24 – 26. Sec. 15.4: Integration in polar, cylindrical and spherical coordinates: Emphasize that polar and cylindrical coordinates are closely related. Triple integrals in spherical coordinates may be done quickly, or skipped entirely if time is short.