Spring 2003

MATH 253A – CALCULUS III (4)

Course Description: Vector calculus; maxima and minima in several variables; multiple integrals; line integrals, surface integrals and their applications.

Prerequisite: 252A

Text. *Calculus Early Vectors* by James Stewart.

Caution. This course covers a lot of material. Good planning is required so that there is enough time left to cover vector calculus (Chapter 14) in the last four weeks. Some topics reoccur in the previous chapters. They need to be covered only once.

Chapter 11: Vectors, geometry of the plane and space, and vector valued functions. (5 weeks)
Cover the entire chapter. Do vectors in $\mathbb{R}^2$ and $\mathbb{R}^3$ more or less simultaneously. Vector addition, scalar multiplication, dot product and cross products. Equations of lines in $\mathbb{R}^2$ and $\mathbb{R}^3$ and equations of planes. Quadric surfaces. Vector valued functions and space curves. Parametric equations in the plane can be done as an example of a vector valued function. Arc length and curvature, velocity, and the components of acceleration for curves in space. Keplers laws of planetary motion (at the end of the chapter) can be covered as an application of the ideas introduced in the chapter.*

Chapter 12: Partial Derivatives. (3 weeks)
Differential calculus for scalar-valued functions of several variables. Graphing surfaces, limits and continuity. The text does not discuss the topology of the plane or space, but at least an elementary treatment is required for the correct statement of the theorems. Then cover partial derivatives, differentiability and tangent planes, followed by the chain rule, directional derivatives and the gradient. The Mean Value Theorem in several variables (not in the text) should be included. Finding and classifying extreme values of a function of several variables, including Lagrange multipliers for constrained optimization problems.

Chapter 13: Multiple integrals, polar, cylindrical, and spherical coordinates. (3 weeks)
Double integrals over rectangles, iterated integrals, double integrals over general regions, polar coordinates, double integrals in polar coordinates, applications of double integrals, surface area, triple integrals, cylindrical and spherical coordinates, triple integrals in cylindrical and spherical coordinates, change of variables in multiple integrals.

Chapter 14: Vector calculus. (4 weeks)
Vector fields, line integrals, the fundamental theorem for line integrals, Green's Theorem, curl and divergence, parametric surfaces and their areas, surface integrals, Stokes' theorem, divergence theorem.

Note: The treatment of Kepler's first law requires the definition of polar coordinates and the description of conic sections in terms of them. This is covered in precalculus and may need to be reviewed. In the book, polar coordinates are treated in a subsequent chapter. Kepler's second law (Exercise 29 on page 713) requires the formula for the area of a sector in terms of polar coordinates, which the instructor may have to provide.