MAT 2443: What to Study for the Final Exam

April 30, 2014

The final exam will have seven questions, each on a major and important topic. (Each question will be worth 15 points, for a total of 105, so there are five free points.) Here are the topics on which to focus your studying. Note that many of these topics involve a variety of other topics that will thus be tested indirectly.

1. Visualization in spacial coordinates.

   Example: See Section 12.1, Exercise 39.

2. Parametric and Cartesian equations of lines and planes in space. From any given information that determines a line or plane (such as two points on a line, three points on a plane, a point and two vectors on a plane, etc.), know how to write both a parametric equation and Cartesian equations (two for a line, one for a plane) to describe the given line or plane. Also know how to convert from one type of equation(s) to the other.

   Examples may be found in sections 12.5, 15.6, 16.6.

3. Differentiation rules; understanding the derivative as a linear map. For vector-valued functions we have two new products: the dot product and the cross product. Both are bilnear and therefore obey the generalized product rule. The Chain Rule generalizes to higher dimensions as the composition of the derivative maps. The derivative function should be thought of as a linear map; it is computed by means of a derivative matrix. (Typically, the notation $Df(x, y, z)$ is used for the derivative map at point (x, y, z) and $f'(x, y, z)$ for the matrix that corresponds to it.) The tangent vector to the curve is a special case of the derivative matrix; it is a matrix with one column. The gradient vector for a function with one real output is also a special case; it is a matrix with one row. Understand all of the above and know how to do the computations! Know how to interpret the derivative in order to

find the differential change in the output that results from a differential change in the input (such as to find the directional derivative in a particular direction, the directions in which the maximum and minimum rates of change occur, the value of the maximum or minimum rate of change, etc.) (Unfortunately, some of this is not clearly explained in the textbook, so study your class notes and the slide presentations given in class.)

4. Understand how to compute the tangential and normal components of acceleration along a curve. See pages 890-891.

5. Application: optimization. Know how to use the first and second derivatives of a real-valued function to find its local maximum and minimum values. Know how to use the constraints on the boundary to find the maximum and minimum values along the boundary. Finally, know how to compare these local extreme values to find the global (absolute) maximum or minimum value and the input at which it occurs. (This last process should be obvious.)

6. Know how to compute the volume of a region from a description of that region.

7. Know how to parametrize a surface and compute its surface area, given a description of that surface.