Exam 1: Learning Goals

**General suggestions for study:** Read carefully through the following learning goals—they represent a pretty complete outline of what competencies you are supposed to have attained via chapters 12 and 13 of our text. For each idea, ask yourself how well you think you understand it. Can you make up a simple problem that tests this idea? Can you solve this simple problem? Can you remember what kinds of book problems were used to test these ideas? If a concept seems pretty clear, move on; if it’s muddy, reread the relevant section in the text.

After playing around with your invented problems a bit, revisit the specific problems that I assigned. These problems will form the basis for the questions I ask in the exam—when I sit down to write the exam, I will assume you have solved these problems, have understood the solutions, and are capable of reproducing this work on an exam. I will also assume that you understand the ideas behind the solutions, and thus can answer conceptual questions that flesh out or expand on these ideas.

Do not wait until the last minute. Start studying early—review two sections/day between now and the exam. Come see me in office hours if you have questions, or see a tutor. Study with a partner if you can—it’s very useful to talk about these things.

**Chapter 12 Learning Goals:**

- Be familiar with the various forms of vector notation; understand the relation between vectors and points; be able to add and subtract vectors, and interpret these operations geometrically.
- Be able to form dot and cross products of vectors, and to interpret these quantities geometrically.
- Understand the ideas of orthogonality, projection, and decomposition; be able to solve basic problems involving these ideas.
- Understand the various forms of equations for planes, and be able to pass between them; be able to write down an equation for a plane that is described geometrically, and describe geometrically a plane whose equation is given.
- Understand what a quadratic surface is; be able to visualize certain simple surfaces. (No need to know the names of these surfaces.)
- Be able to describe a point in $\mathbb{R}^3$ using rectangular, cylindrical, and spherical coordinates; understand all these coordinate systems geometrically; be able to describe certain simple surfaces using these coordinate systems (eg. planes, spheres, cylinders, cones, etc.)

**Chapter 13 Learning Goals:**

- Understand what a curve is; be able to write down multiple different parameterizations for certain simple curves (eg. lines, circles, ellipses, etc.)
- Understand the idea of the velocity vector; how is it calculated? where does it point? what does it mean?
- Understand how the velocity vector and the unit tangent vector are related; be able to calculate the unit tangent vector given a parameterization of a curve; be able to write down a parameterization of a tangent line.
• Understand geometrically how the unit tangent vector and the unit normal vector are related; be able to calculate the unit normal given a parameterization of a curve.

• Be able to write down the integral that gives the arc length of a curve; understand why this integral gives the arc length; understand the idea of an arc length function.

• Understand the idea of an arc length parameterization of a curve; know how to find one, given a non-arc length parameterization; understand why arc length parameterizations are desirable.

• Understand what curvature is; be able to calculate the curvature of a parameterized curve \( \mathbf{r}(t) \) at a point \( t_0 \); be able to calculate the curvature of a curve \( y = f(x) \) at a point \( x_0 \); understand the idea of an osculating circle, and be able to calculate the equation for one, given a parameterization of a curve.