Study Guide for Exam 1

12.1–12.2: Vectors and lines. Know: *point*, *origin*, *vector*, *equivalent vectors*, *position vector*, *zero vector*, *scalar*, *linear combination*, *standard basis vectors*, *coordinate planes*. (all in 2 and 3 dimensions!) Know the notation for vectors and be able to write them in components. Know how to compute the *magnitude* of vectors, and what is a *unit vector* and how to make a unit vector in the direction of a given vector. Know the algebraic laws for vector manipulation and know the *parallelogram law*. Know how to find *parametric equations* for a line (given its description for example two points on the line, or a point and a vector) and how to find the intersection of two lines. Finally know the *right hand rule orientation*.

12.3: Dot product. Know definition and properties of the dot product. Be able to compute it. Know how it relates to the angle between two vectors. (the formula $\mathbf{v} \cdot \mathbf{w} = \|\mathbf{v}\|\|\mathbf{w}\| \cos\theta$). Know how to check for *perpendicular* or *orthogonal* vectors. Know what a *projection* is and how to compute it.

12.4: Cross product. Be able to compute 2×2 and 3×3 determinants. Know how to compute the cross product of two vectors. Know $\|\mathbf{v} \times \mathbf{w}\| = \|\mathbf{v}\|\|\mathbf{w}\||\sin\theta|$. Know that the cross product is orthogonal to the two vectors and know how to find out where it points using the right hand rule. Know that it is anticommutative and not commutative ($\mathbf{v} \times \mathbf{w} = -\mathbf{w} \times \mathbf{v}$) and other algebraic rules. Know how to use it to compute the area of a parallelogram in the plane and how to use it to compute the volume of a parallelepiped spanned by 3 vectors.

12.5: Planes. Know what is an equation for the plane and how to find it given two vectors and a point, or three points in the plane. Know *normal vector* and *unit normal vector*. Know how to find the intersection of a plane and a line.

11.1 and 13.1: Parametric equations and vector valued functions. Know what are parametric equations for a curve and how to write them in vector notation. Know how to find them given a description of the geometric object. Both in the plane and in 3 dimensions. Know how to project onto coordinate planes. Know how to find intersections of two surfaces.

13.2: Calculus with vector valued functions. Be able to take limits, compute derivatives, integrals and antiderivatives of vector valued functions. Know the sum and product rule (for all products). Know what is a tangent line and how to find its equation and how it relates to the derivative. Know the fundamental theorem of calculus for vector valued functions.

11.2 and 13.3: Arclength and speed: Know that the magnitude of the derivative is the *speed* of a particle. Know that the integral of the speed is the *arclength* of the particles path. Be able to compute arclength.

13.5: Motion in 3-space. Know what is *position*, *velocity*, *speed*, *acceleration*. Know how to solve for position and velocity given acceleration and initial velocity and position. Note that the formulas in Rogawski have a typo. Use

$$\mathbf{v}(t) = \int_0^t \mathbf{a}(s)ds + \mathbf{v}_0$$

$$\mathbf{r}(t) = \int_0^t \mathbf{v}(s)ds + \mathbf{r}_0$$

14.1: Functions of two or more variables. Know what is a function of more than one variable be able to sketch a graph of simple a function. Know what are *horizontal* and *vertical traces*. Know what level curves are. Know how to find the *average rate of change*.