Math 217: Learning Goals

A student successfully completing Math 217 (Fall 2019) should:

- understand **vector functions** of one variable, their use in describing space curves (their tangent vectors, lengths), and in describing motion in space (position, velocity/speed, acceleration)
- be able to recognize the equations of and roughly **sketch simple surfaces** such as planes, spheres, ellipsoids, paraboloids and hyperboloids
- understand **functions of several variables**, their domains, ranges, graphs, level curves/surfaces, limits, and continuity
- understand the definition, computation, and interpretation of **partial derivatives**; their relation to the tangent plane and their role in linear approximation; higher partials and equality of mixed partials
- know and be able to use the various forms of the **chain rule** for functions of several variables
- know the **gradient** vector and its meaning, and its relation to level curves/surfaces and to directional derivatives
- be able to find local and global **maximum and minimum values** of functions of several variables, and use Lagrange multipliers for constrained problems
- understand the definition and simple applications (volumes, centres of mass) of **double and triple integrals**, and be able to compute them as iterated integrals using rectangular, polar, cylindrical or spherical coordinates
- know what **vector fields** are and how to represent them graphically
- know how to to compute **line integrals** of functions (with respect to arc length or one of the coordinates) and vector fields, by parameterizing the curve
- know what **conservative vector fields** are, how to detect them using curl (or its 2D version), the path-independence property of their line integrals, and the **fundamental theorem for line integrals**
- understand **parametric surfaces**, their normals and surface areas, and how to compute **surface integrals** of (scalar) functions and vector fields by parameterizing the surface
- know how to compute the **curl and divergence** of a vector field, the basic calculus of div, grad, and curl (eg. product rules with dot or cross products, etc.), and that curl grad = 0 and div curl = 0
- understand the statements of the **theorems of Green, Stokes, and Gauss (divergence)** and be able to use them to compute/relate line, surface, and double/triple integrals
- understand the basics of differential forms in $\mathbb{R}^3$. Namely, wedge product, exterior differentiation, and the dictionary between these concepts and the usual notions from vector calculus (functions, vector fields, dot product, cross product, gradient, curl, and divergence). Understand the statement of the generalized Stoke's theorem in this context.