MATH 280C Multivariate Calculus Spring 2013

Objectives for Exam #4

A well-prepared student for Exam #4 should be able to

- determine the equation of a plane given appropriate information
- use cross-sections to describe and sketch the surface given by a quadratic equation in three variables
- determine the boundary of a region; determine whether a region is open, closed, or neither; and determine whether a region is bounded or unbounded
- use path limits to show that a given limit does not exist for a function of several variables
- state the definition of a partial derivative (as limit of a difference quotient)
- read, with understanding, the various notations for partial derivatives
- use an appropriate chain rule to compute or express derivatives for a given composition of functions
- state and use the dot and cross products appropriately
- determine the equation of a plane given appropriate information
- compute infinitesimal displacement vectors along a curve
- understand the structure of level curves/surfaces in a zoomed-in view at a point
- articulate how gradient vectors are related to level curves/surfaces and greatest rate of change
- compute a directional derivative given a function, an input, and a direction
- use a linearization to approximate outputs of a function for inputs near a given input
- find all possible local minimizers and local maximizers for a given function on a given domain
- find and classify (as local minimizer, local maximizer, or neither) all critical points for a given function on a given domain
- articulate how to find the global minimum and global maximum for a given function on a given domain
- analyze a given applied optimization problem
- use Lagrange multipliers to locate local mimimizers or maximizers of a given constrained optimization problem
- use cartesian, polar, cylindrical, or spherical coordinates to describe points, curves, regions in the plane, and solids in three space (including transforming from one coordinate system to another if needed)
- know the cylindrical and spherical coordinate transformations and be able to graph simple equations expressed in those coordinates
- state and use basic properties of double and triple integrals
- state and apply Fubini's Theorem as presented in class
- set up an iterated integral (in a chosen or specified coordinate system) equal to a double or triple integral for a given function and given region in the plane

- change the order of integration of an iterated integral in cartesian, polar, cylindrical, and spherical coordinates
- evaluate a given iterated integral
- construct and evaluate an integral to compute the total for some quantity given a region and a density for that quantity
- articulate a fundamental meaning for each type of integral we have studied
- state a geometric meaning of the cross product
- compute the area of a parallelogram or of a triangle given the coordinates of vertices
- determine (by either computation of geometric argument) an expression for an infinitesimal area element for a given surface in space
- evaluate a surface integral for a given function (i.e., scalar field) and a given surface in space either by a geometric argument or be setting up and evaluating an equivalent iterated integral (in two variables)
- construct and evaluate an integral to compute the area of a given surface
- construct and evaluate an integral to compute the total for some quantity given a surface and an area density along that surface
- evaluate a line integral for a given vector field and given curve in the plane or in space either by a geometric argument or by setting up and valuating an equivalent definite integral (in one variable)
- interpret a line integral for a vector field in terms of either work or fluid flow
- use the component test to determine whether or not a given vector field is conservative (that is, has a potential function) for a given region
- find a potential function for a given conservative field
- use the Fundamental Theorem of Line Integrals to evaluate a given line integral for a vector field
- understand and articulate the connection between a vector field having a potential function, path-independence of line integrals for the vector field, and the value of line integrals for that vector field along closed curves
- evaluate a surface integral for a given vector field and a given surface in space either by a geometric argument or by setting up and evaluating an equivalent iterated integral (in two variables)
- interpret a surface integral for a vector field in terms of fluid flow
- compute the divergence of a given vector field and interpret a divergence value in terms of fluid flow
- compute the curl of a given vector field and interpret a curl vector in terms of fluid flow
- evaluate a given integral indirectly by using the Divergence Theorem to trade in for an equivalent expression that is more easily evaluated
- use the Divergence Theorem to relate information about the derivative of a function over a region to the integral of that function over the edge of the region