MATH 53 SPRING 2018 MIDTERM 2 LIST OF TOPICS

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The second midterm will be based on the first 21 lectures of the class, except for optimization (lectures 9-10), i.e., it is cumulative. I am not doing this to be mean — it is because you really need to understand partial derivatives, chain rule, gradient, linear approximations, etc. in order to understand the material in the second part of the course. That said, the exam will focus on testing concepts after lecture 10, and material up to then will only be relevant as a prerequisite (e.g., I will not explicitly ask you about total differentials).

Here is a list[1] of things you should know / know how to do in addition to the list for midterm 1; if you are comfortable with everything on this list, you should be fine.

The emphasis will be on computational problems, conceptual questions, and occasionally visualization, and not on formal proofs. However, you should know all of the definitions and informal proofs that were covered in lecture.

- Know the definition, interpretation, and basic properties of double integrals.
- Compute double integrals over rectangles using Fubinis theorem, treating the outer variable as a constant in the inner integral.
- Compute double integrals over more general regions (such as type 1 and 2), using the geometry of the region to write the correct limits of integration.
- Change the order of integration in double integrals.
- Calculate the area of a domain in R^2 or the volume between the graphs of two functions using a double integral.
- Calculate double integrals in polar coordinates.
- Understand why the magnification factor r is needed for double integrals in polar coordinates.
- Convert double integrals from Cartesian coordinates to polar coordinates and vice-versa.
- Evaluate triple integrals over rectangles.
- Evaluate triple integrals over more general regions.
- Change the order of integration in triple integrals, by drawing pictures, and by logically reasoning through inequalities.
- Calculate the center of mass of a solid with varying mass density.
- Know the cylindrical and spherical coordinate systems.
- Convert points and regions between Cartesian, cylindrical, and spherical coordinates.
- Evaluate triple integrals in cylindrical and spherical coordinates using the correct magnification factors.
- Know the definition and significance of the Jacobian of a transformation.
- Know the change of variables formula for integrals in 2 variables (don't need to know 3 variables).
- Execute a change of variables by working out the change in the geometry of the region and computing the Jacobian.
- Find a change of variables to make an integral simpler, in easy cases.
- Definition of vector fields and conservative vector fields.
- How to find a potential function for a conservative vector field by integration.

[1]This list is a modified version of a similar list produced by Prof. Hutchings for a previous version of this course.

- Definition of a line integral of a function with respect to arc length, its significance, and how to compute it.
- The definition of a line integral of a vector field, its significance, and how to compute it.
- Statement and proof of the fundamental theorem of line integrals.
- How to use the fundamental theorem of line integrals to evaluate line integrals of conservative vector fields.
- A vector field is conservative if and only if its line integral along every closed curve is zero if and only if line integrals are independent of path.
- Intuitive definition of a simply connected domain in R^2
- The definition of a flux integral across a simple connected curve in $2D$ and how to compute it.
- Statement of Greens theorem, both work/curl and flux/divergence forms.
- How to compute area using Green's theorem.
- A vector field on a simply connected domain is conservative if and only if $Q_x = P_y$.
- Definition and physical interpretation of *div* and *curl* in 2D.