

# Introduction to Geometric Measure Theory

Math 583

Spring 2021

## INSTRUCTOR INFORMATION:

Instructor: Tatiana Toro

Class meetings: WF

Class location: **zoom** link posted on [canvas](#) (you need to be registered)

Phone: 206-543-1173.

E-mail: [toro@uw.edu](mailto:toro@uw.edu)

Course website [here](#).

Office hours: or by appointment.

Geometric Measure Theory (GMT) is a classical subject in geometric analysis which in recent years has seen a new revival. Tools introduced to study perimeter minimizers and minimizing surfaces have found applications in areas such as metric geometry, harmonic analysis, free boundary problems and theoretical computer sciences. The goal of this course is to introduce the subject including some of the fundamental results concerning perimeter minimizers. This course can be seen as a continuation of Math 524 and can be taken in parallel with Math 525.

The goal is to cover the following topics:

- Advanced Measure Theory
  - Covering Theorems
  - Differentiation of Radon Measures
  - Riesz Representation Theorem
  - Weak Convergence
- Hausdorff Measures
- Area and Coarea Formulas
  - Lipschitz Functions, Rademacher's Theorem
  - The Area Formula

- The Co-area Formula
- First and Second Variation formulae
- Sobolev Functions
- Functions of Bounded Variation, Sets of Finite Perimeter
  - Definitions, Structure Theorem
  - Approximation and Compactness
  - Co-area Formula for BV Functions
  - Isoperimetric Inequalities
  - The Reduced Boundary
  - Gauss-Green Theorem
  - Perimeter minimizers: first results.

## REFERENCES:

- [EG] Measure Theory and Fine Properties of Functions, Revised Edition, L. C. Evans & R. F. Gariepy
- [M1] Sets of Finite Perimeter and Geometric Variational Problems, F. Maggi.
- [M2] Geometry of sets and measures in Euclidean spaces : fractals and rectifiability, P. Mattila.
- [S] Lectures on geometric measure theory, L.M. Simon.

**Course structure:** This term we will use a mixture of learning/teaching modalities. Student will have access to the lectures (notes and partial recordings of lectures). Students are expected to go over the lectures (asynchronous learning). Class time Wednesday and Friday (synchronous learning) will include class discussion. We will go over the concepts presented in the notes as well as problems. A Q&A session will be included in the Wednesday and Friday meetings as well. If possible we will use a video conference format for these meetings. My intention is to record the discussion of the problems and the Q&A session, and make it available after class.

## The learning process will consist of three major parts:

- Class time – lectures, discussions, questions and presentations by the students
- Independent study: reviewing lecture notes, reading, working on suggested problems and preparing for presentations
- Office hours: informal time for questions/discussions with the instructor

**Grading Policy:** This is a topics course so the grade will be determined by involvement and participation. Problems will be suggested and students will be encouraged to attempt them. Some of the will be discussed in class others in additional sessions. The grade will be based on students participation. Participation in the discussion board will be taken into account.

**Technology:** Classes will take place on line via zoom. Your invitations to class will be sent to your @uw.edu account. Open the first one ahead of time so that you can download zoom. If you prefer you can download UW zoom [here](#).

**Religious Accommodations:** Washington state law requires that UW develop a policy for accommodation of student absences or significant hardship due to reasons of faith or conscience, or for organized religious activities. The UW's policy, including more information about how to request an accommodation, is available at [Religious Accommodations Policy](#) . Accommodations must be requested within the first two weeks of this course using the [Religious Accommodations Request form](#) .

**The UW Food Pantry:** A student should never have to make the choice between buying food or textbooks. The UW Food Pantry helps mitigate the social and academic effects of campus food insecurity. They aim to lessen the financial burden of purchasing food by providing students with access to food and hygiene products at no-cost. Students can expect to receive 4 to 5 days' worth of supplemental food support when they visit the Pantry. For information including operating hours, location, and additional food support resources visit [The UW Food Pantry](#). They can be found on the North side of West Campus' Poplar Hall at the corner of Brooklyn Ave NE and 41st.