MATHEMATICS 721 A1
Introduction to Differential Topology I
Fall Semester 2022

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Lectures: MWF 12:20-1:10pm in CAS 221

Text: *Introduction to Smooth Manifolds*, 2nd Edition, by John M. Lee; Springer; ISBN-13: 978-1441999818. An errata page is available here.

My Office Hours: TBA

Class Web Pages: Class announcements will be posted on the class Blackboard site at learn.bu.edu Homework assignments will be posted on Gradescope. Gradescope can be accessed through a tab in Blackboard.

Content: A smooth n-dimensional manifold is a space obtained by gluing together copies of $\mathbf{R}^n$ by using smooth maps. Standard examples of smooth n-manifolds are $\mathbf{R}^n$ itself, n-spheres, or n-dimensional real projective spaces.

Differential topology is the study of smooth manifolds and it merges tools from calculus with ideas from topology. A key point in definition of a smooth manifold is that it provides a description of the space (and interesting equations on them) in a coordinate independent manner. This is a very powerful idea which has many applications to many other areas of mathematics. Differential topology also has many applications to theoretical physics since the fundamental equations of nature are coordinate invariant.

In this course, we will introduce smooth manifolds, smooth maps, tangent bundles and vector fields, cotangent bundles, vector bundles, immersions and submersions, tensors, Lie groups and Lie algebras, orientations, differential forms and integration, de Rham cohomology, integral curves and flows, Lie derivatives, and foliations.

Prerequisites: The prerequisites to this course are multivariate calculus, basic concepts from linear algebra and from topology.

Homework: Homework will be assigned periodically on Gradescope. Homework will be uploaded as a PDF file to Gradescope. Late homework will not be accepted. Students may discuss homework with each other (and are encouraged to do so) but all written work must be prepared independently.

Final Presentation: Students will be asked to give a presentation at the end of the semester on a topic related to the course, chosen in consultation with the instructor.

Grades: Your final grade is determined by the homeworks and the final presentation. Grades are based upon the formula:

$$\text{Final Grade} = \frac{2}{3}(\text{ Homework Average}) + \frac{1}{3}(\text{Final Presentation})$$