

## Math 8720: Differential Topology

Fall 2022

Syllabus

INSTRUCTOR: Slava Krushkal (KER 321), e-mail: krushkal@virginia.edu

CLASS MEETINGS: Tuesday, Thursday 12:30PM - 1:45PM, Monroe Hall 114.

OFFICE HOURS: Monday 2-3, Wednesday 2:30-3:30, and by appointment.

**Textbooks:** The course will not be based on one specific text. However, John Milnor's "Topology from the Differentiable Viewpoint" (Revised Edition, 1997), ISBN 0691048339, and especially Loreng Tu's "An Introduction to Manifolds", 2nd Edition, ISBN 1441973990 will be very helpful references.

Some other useful texts are: J. M. Hirsch "*Differential topology*", V. Guillemin-A. Pollack "*Differential Topology*", J. Lee "Introduction to Smooth Manifolds". Some of these books will be put on reserve in the library.

**Prerequisites:** Math 4770: General topology and Math 4330: Calculus on Manifolds.

### **Course material:**

- Definition of smooth manifold (in  $\mathbb{R}^n$ , and also not in  $\mathbb{R}^n$ ), tangent vectors, tangent bundle. Examples including projective spaces and classical Lie groups.
- Maps between manifolds, induced maps on tangent bundles; regular values, local structure theorems (inverse/implicit function theorem), Sard's theorem.
- Submanifolds; immersions and embeddings; transversality.
- Partitions of unity; Whitney embedding theorem.
- Orientation of manifolds; manifolds with boundary and induced orientation.
- Degrees of smooth maps; homotopy invariance of degree; applications such as Brouwer fixed point theorem, linking number.
- Vector bundles: tangent bundle, normal bundle, duals, tensor bundles. Structures on bundles including inner products, specifically Riemannian metrics.
- Differential forms: exterior algebra, exterior derivative.
- Integration of forms on oriented manifolds; Riemannian volume form; Stokes' theorem.

**Homework:** Homework will be assigned biweekly.

### **Grading policy :**

<b>Final Exam</b>	35%
<b>Homework</b>	45%
<b>Class participation</b>	20%

**Questions and feedback:** I'm happy to talk after class meetings and during office hours.

**Phones and laptops** are a distraction to other students and should not be used during class meetings, unless they're used for note taking.