MATH-140A-1
Geometric Analysis
Fall 2017

Course information:

Time and place:	Tuesday and Thursday 5pm-6:20pm in Room 117 Goldsmith
Instructor:	Jingyu Zhao
Office:	Goldsmith 208
Email:	jyzhao@brandeis.edu
Office hours:	Tuesdays from 4pm to 5pm and Thursdays from 11am to 12am

Course description:

Textbook: Frank Warner, Foundations of Differentiable Manifolds and Lie Groups.
Material to be Covered:
The course covers Chapters 1,2,4,5,6 of the textbook. Chapter 1 introduces the concept of smooth manifolds, tangent vectors and differentials. We will focus on proving the Inverse Function Theorem, the Implicit Function Theorem and the Frobenius Theorem. Chapter 2 defines tensors, differential forms and Lie derivatives. Chapter 4 covers integration on smooth manifolds, stoke's Theorem and de Rham cohomology. In Chapter 5, we begin to study sheaves and sheave cohomology and prove version of the de Rham Theorem. We end with Chapter 6 which is the study of the Laplace-Beltrami operator (as an elliptic operator) in Hodge theory.

Homework: You will turn the written assignments **in class on Tuesdays**. Collaboration and discussion with your classmates is highly encouraged, but you must write up assignments individually.

The final exam: The final exam will be closely related to the homework assignments. You should understand how to do every problem correctly.

Grading: The final course grade will be determined by

Homework:	75%	(One lowest homework score will be dropped)
Final exam:	25%	

Students with disabilities: Students with disabilities requiring special accommodation should contact the Student Accessibility Support (SAS). Please inform me a week before an exam of any special arrangements that need to be made.

Tentative Syllabus:

Date	Topics	Sections to read
8/31	Course overview and smooth manifolds	1.0-1.6
9/05	Tangent vectors and differentials	1.12-1.24
9/07	Submanifolds and Inverse Function Theorem	1.27-1.36
9/12	Tangent vectors and differentials	1.12-1.24
9/07	Implicit Function Theorems and transversality	1.37-1.40
9/14	Vector bundles	1.25,1.44,1.45; 1.54-1.59,2.1-2.13
9/19	Vector fields and Frobenius Theorem	1.41-1.43,1.46-1.50,1.53; 1.5-1.64
9/21	Rosh Hashanah: No class	
9/26	Frobenius Theorem	2.26-2.32,2.24,2.25
9/28	Tensors and exterior algebras	2.1-2.10, 2.14-2.23
10/03	Differential forms and Lie derivatives	2.14-2.23;2.24-2.25
10/05	Sukkot: No class	
10/10	Lie derivatives and Lie groups (if interested)	2.24-2.25; 3.1-3.11
10/11	de Rham cohomology of $\mathbb{R}^n$	4.13-4.15,4.18,4.19, 4.4-4.6
10/17	Integration on singular chains	4.6,4.7,4.16,4.17
10/19	Integration on oriented manifolds	4.1-4.3,4.8-4.10
10/24	(Co-)Chain complexes	5.16,5.17
10/26	Presheafs and sheaves	5.1-5.3,5.5-5.8
10/31	Presheafs and sheaves (ct'd)	5.4,5.11
11/02	Cech Cohomology	5.33
11/07	de Rham Theorem (weak version)	5.10-5.12, 5.28-5.30; GH p43-45top
11/09	Free resolutions and cohomology	5.18-5.25,5.27
11/14	de Rham Isomorphism Theorem	5.31,5.32,5.34-5.38
11/16	Hodge Decomposition Theorem	6.1-6.3,6.7-6.14
11/21	Elliptic operators	6.4-6.6,6.28,6.34-6.36
11/23	Thanksgiving: No class	
11/28	Applications of elliptic regularity	6.8,6.31
11/30	Proof of elliptic regularity	6.29,6.32,6.33
12/05	Final Review	