Differential Topology
Math 5392-002 – Fall 2011

Time: Tuesday, Thursday 12:30 – 1:50 PM
Instructor: Prof. Barbara Shipman
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Classroom: Pickard Hall 103
Office: Pickard Hall 437
Office Hours: Mon 9—11 AM, Tue 4--5 PM, Wed 1--3 PM, and by appointment.

Website: www.uta.edu/faculty/shipman
Go to the Student Center, Math 5392, to view the assignment schedule.

Prerequisite: Basic principles of linear algebra and multi-dimensional calculus and good skill in writing proofs.


Course Content: This course will develop foundations of differential topology and explain the relevance and applications of the material to other areas of mathematics and the sciences. A colorful array of differential manifolds will supplement Chapter 1 of the text, including projective spaces, flag manifolds, and homogeneous spaces. We will discuss much of the material in Chapters 1 through 4, spending more time on some sections than others according to the interests of the class, within the time constraints of the course.

Major topics:

Chapter 1: Manifolds and Smooth Maps. Differential manifolds, tangent spaces, smooth maps, immersions, submersions, the inverse function theorem, transversality, homotopy, Sard’s theorem, Morse functions, and embedding manifolds into Euclidean spaces.

Chapter 2: Transversality and Intersection. Manifolds with boundary, more on transversality, intersection theory modulo 2, winding numbers, the Jordan-Brouwer separation theorem.

Chapter 3: Oriented Intersection Theory. Orientation of manifolds, oriented intersection number, the Lefschetz fixed-point theorem, the Poincaré-Hopf theorem, the Hopf degree theorem, and the Euler characteristic.

Chapter 4: Integration on Manifolds. Differential forms, exterior derivative of differential forms, the generalized Stokes' theorem, the Gauss-Bonnet theorem.

Learning Outcomes: The goals upon completion of the course are to be able to

- analyze conceptually and computationally the foundational principles of differential topology, both in concrete examples and in abstract formulations, and to
- provide an array of interesting and relevant examples to illustrate and explain each major concept of the course.
Seminar-Style Class: This course will be conducted in a seminar style in which you will take an active part in the development and explanations of the material. Bring your textbook to every class. We will analyze the material, ask questions about it, add to it, and view it through illustrative examples in a collaborative seminar setting.

Class Preparation and Participation: At each class meeting, I will take attendance and assign a Class Preparation (CP) for you to complete and bring to the next class. A CP may be a Critical Study (CS) of assigned reading or a problem to work out and write up. For each CS, complete the following three components:

- Study the reading carefully.
- Write down three elucidations that illuminate specific parts of the reading. An Elucidation may be a well-chosen example to illustrate a concept, a diagram that helps one to picture an idea, another perspective from which to view the concept, or anything else that you think will help you and the class understand the reading.
- Write down two thoughtful questions about any part of the reading.

At the next class, I will call on members of the class to present selected elucidations and questions as we study the material in more depth. As time permits, I will also ask students to explain their solutions to selected homework problems.

Here is the point scheme: 2 points for arriving on time and being present, prepared, and engaged during the full class period; 1 point for arriving late or leaving before the class is over, or for an incomplete CP or inadequate participation; 0 points for missing the class. You are responsible all announcements made in class.

Homework: I will assign homework problems each week, due at the beginning of class on the following Thursday. Guidelines for homework:

- State the full question or problem before presenting your solution.
- Carefully explain your reasoning and solution strategies in all written work. Explain the purpose and interpretation of all calculations.
- Write neatly in dark writing or type your work.

Each problem will be given a letter grade as follows. These will be averaged to compute the overall HW score.

A+ (100)  Perfect solution, carefully-crafted, fully-explained, and beautifully written
A  (95)   Almost all clear and correct, well-written, and well-explained
B  (85)   Good thinking but with some lack of clarity, correctness, or completeness of explanations
C  (75)   Some explanations on right track but contains major flaws in correctness, clarity, and/or completeness.
D/F (50/0) Overall incorrect, unclear, and/or incomplete work

Quizzes: Five 30-minute quizzes at the beginning of class on the dates listed below will test your knowledge and understanding of basic definitions, statements, and concepts and help keep you fluent on the vocabulary and concepts used daily in class. One lowest quiz score will be dropped.
Final Project: A final project will take the place of a final exam. During the time of the scheduled final, you will hand in your written paper and present your project to the class.

Grading: Your work will be graded on clarity, correctness, completeness, and creativity of your explanations and solutions.

Class preparation and participation: 20%
Homework: 30%
Four best quizzes: 30%
Final project: 20%

A course average of at least 90% guarantees an A, at least 80% a B, at least 70% a C.

Important dates
Aug 25 First class
Sep 13 Quiz 1
Sep 29 Quiz 2
Oct 20 Quiz 3
Nov 4 Last day to drop (automatic W)
Nov 10 Quiz 4
Nov 24–27 Thanksgiving Break
Dec 1 Quiz 5
Dec 8 Last class
Dec 15 Final Projects and Presentations 11 AM --1:30 PM

Policies of the University of Texas at Arlington:

Drop Policy: Students may drop or swap (adding and dropping a class concurrently) classes through self-service in MyMav from the beginning of the registration period through the late registration period. After the late registration period, students must see their academic advisor to drop a class or withdraw. Undeclared students must see an advisor in the University Advising Center. Drops can continue through a point two-thirds of the way through the term or session. It is the student's responsibility to officially withdraw if they do not plan to attend after registering. Students will not be automatically dropped for non-attendance. Repayment of certain types of financial aid administered through the University may be required as the result of dropping classes or withdrawing. Contact the Financial Aid Office for more information.

Americans with Disabilities Act: The University of Texas at Arlington is on record as being committed to both the spirit and letter of all federal equal opportunity legislation, including the Americans with Disabilities Act (ADA). All instructors at UT Arlington are required by law to provide "reasonable accommodations" to students with disabilities, so as not to discriminate on the basis of that disability. Any student requiring an accommodation for this course must provide the instructor with official documentation in the form of a letter certified by the staff in the Office for Students with Disabilities, University Hall 102. Only those students who have officially documented a need for an accommodation will have their request honored. Information regarding diagnostic criteria and policies for obtaining disability-based academic accommodations can be found at www.uta.edu/disability or by calling the Office for Students with Disabilities at (817) 272-3364.
Academic Integrity: It is the philosophy of The University of Texas at Arlington that academic dishonesty is a completely unacceptable mode of conduct and will not be tolerated in any form. All persons involved in academic dishonesty will be disciplined in accordance with University regulations and procedures. Discipline may include suspension or expulsion from the University. According to the UT System Regents’ Rule 50101, §2.2, "Scholastic dishonesty includes but is not limited to cheating, plagiarism, collusion, the submission for credit of any work or materials that are attributable in whole or in part to another person, taking an examination for another person, any act designed to give unfair advantage to a student or the attempt to commit such acts."

Student Support Services Available: The University of Texas at Arlington provides a variety of resources and programs designed to help students develop academic skills, deal with personal situations, and better understand concepts and information related to their courses. These resources include tutoring, major-based learning centers, developmental education, advising and mentoring, personal counseling, and federally funded programs. For individualized referrals to resources for any reason, students may contact the Maverick Resource Hotline at 817-272-6107 or visit www.uta.edu/resources for more information.

Electronic Communication Policy: The University of Texas at Arlington has adopted the University “MavMail” address as the sole official means of communication with students. MavMail is used to remind students of important deadlines, advertise events and activities, and permit the University to conduct official transactions exclusively by electronic means. For example, important information concerning registration, financial aid, payment of bills, and graduation are now sent to students through the MavMail system. All students are assigned a MavMail account. Students are responsible for checking their MavMail regularly. Information about activating and using MavMail is available at http://www.uta.edu/oit/email/. There is no additional charge to students for using this account, and it remains active even after they graduate from UT Arlington.

To obtain your NetID or for logon assistance, visit https://webapps.uta.edu/oit/selfservice/. If you are unable to resolve your issue from the Self-Service website, contact the Helpdesk at helpdesk@uta.edu.