Math 365G: Curves and Surfaces

Unique Number 57155

Spring Semester 2009

Where am I?

You are in Associate Professor Dan Knopf's Math 365G class.
Lectures meet 12:00–12:50 Mondays, Wednesdays, and Fridays in RLM 7.118.

Why am I here?

Differential geometry is a rich and active area of research. Besides being an important part of pure mathematics, it provides powerful tools for disciplines like general relativity and other branches of mathematical physics, as well as for applications in engineering and computer graphics. This course will introduce you to the basic language and methods of differential geometry by studying the geometry of n-dimensional hypersurfaces in $(n+1)$-dimensional Euclidean space. This course would be excellent preparation for graduate courses in Differential Topology or Riemannian Geometry, as well as for further study in applications like those listed above.

To succeed in this course, you will need a basic understanding of multivariable calculus and linear algebra. A moderate degree of mathematical maturity (i.e. some prior familiarity with proof and abstraction) will be helpful. You should plan to read the text intently, attend class regularly, and devote careful attention to homework. Reading is important in any advanced math course, both to reinforce and to augment the material covered in class. Class attendance is especially important in this course, because differential geometry is a very difficult subject to learn on one's own. And homework is surely the most important aspect of learning any part of mathematics: just as one cannot learn to play the piano by watching a virtuoso, neither can one learn mathematics merely by watching one's instructor.

What are the prerequisites for this course?

The prerequisite is credit or concurrent registration in Math 365C, *Real Analysis I.*

What materials should I have?

You need the following textbook: *Elementary Topics in Differential Geometry,* John A. Thorpe, Springer–Verlag, New York, 1979. (ISBN 0-387-90357-7)

How can I get extra help?

- Assignments, solutions, and announcements will be posted on BLACKBOARD. A discussion board will be provided there for you to post questions and get help.
- You are also encouraged to ask for individualized help at any time. My contact information is as follows:
  - *E-mail:* danknopf@math.utexas.edu
  - *Office:* RLM 9.152
  - *Phone:* 471.8131
  - *Office hours:* Mondays and Fridays 2:30–4:00 (and by appointment)
- The University of Texas at Austin provides, upon request, appropriate academic accommodations for qualified students with disabilities. For more information, contact the Office of the Dean of Students at 471.6259 or 471.6441 (TTY). If you fall under the University's Learning Disability Policy, it is your responsibility to present the Dean of Student's certification of that fact to me as soon as possible.

How will the course be graded?

- There will be six homework assignments, each worth 10% of your grade. See the schedule below.
- The remainder of your grade will be divided equally between two take-home exams.
- The midterm, worth 20% of your grade, is due at the start of class on Friday, March 13, the last class day before spring break.
- The final, worth 20% of your grade, is due in my office at 5:00 PM on Wednesday, May 13, the final exam time chosen by the Registrar.
- **Late homework or exams will be penalized substantially: 10% of available points are lost each late day.**

Your overall grade will be computed according to the following scale:

A	90–100
B	80–89
C	70–79
D	60–69
F	0–59

What is the lecture schedule?

The following lecture schedule may be altered for pedagogical reasons. **It is your responsibility to be aware of any changes announced in class.**

Wednesday, January 21 Introduction

Friday, January 23 *Chapter 1:* Graphs and level sets

Monday, January 26 *Chapter 2:* Vector fields

Wednesday, January 28 *Chapter 2:* Vector fields and flows

Friday, January 30 *Chapter 3:* Tangent space

Monday, February 2 *Chapter 3:* Tangent space **(Homework 1 due)**

Wednesday, February 4 *Chapter 4:* Hypersurfaces in $\mathbb{R}^{n+1}$

(Last day to drop with a possible refund)

Friday, February 6 *Chapter 4:* Hypersurfaces in $\mathbb{R}^{n+1}$

Monday, February 9 *Chapter 5:* Tangent and normal vector fields

Wednesday, February 11 *Chapter 5:* Orientation

Friday, February 13 *Chapter 6:* Gauß map

Monday, February 16 *Chapter 6:* Gauß map **(Homework 2 due)**

(Last day to drop without possible academic penalty)

Wednesday, February 18 *Chapter 6:* Gauß map

Friday, February 20 *Chapter 7:* Geodesics

Monday, February 23 *Chapter 7:* Geodesics

Wednesday, February 25 *Chapter 7:* Geodesics

Friday, February 27 *Chapter 8:* Parallel transport

Monday, March 2 *Chapter 8:* Parallel transport **(Homework 3 due)**

Wednesday, March 4 *Chapter 8:* Parallel transport

Friday, March 6 *Chapter 9:* Weingarten map

Monday, March 9 *Chapter 9:* Weingarten map

Wednesday, March 11 *Chapter 9:* Weingarten map

Friday, March 13 *Chapter 10:* Curvature of plane curves **(Midterm Exam due)**

March 16 – March 20 Spring Break — no class

Monday, March 23 *Supplemental:* Differential forms

Wednesday, March 25 *Supplemental:* Differential forms

Friday, March 27 *Chapter 11:* Arc length and line integrals

Monday, March 30 *Chapter 11:* Arc length and line integrals

(Last day to drop for academic reasons)

Wednesday, April 1 *Chapter 11:* Arc length and line integrals

Friday, April 3 *Chapter 12:* Curvature of surfaces

Monday, April 6 *Chapter 12:* Curvature of surfaces **(Homework 4 due)**

Wednesday, April 8 *Chapter 12:* Curvature of surfaces

Friday, April 10 *Chapter 14:* Parameterized surfaces

Monday, April 13 *Chapter 14:* Parameterized surfaces

Wednesday, April 15 *Chapter 14:* Parameterized surfaces

Friday, April 17 *Chapter 15:* Local equivalence of surfaces

Monday, April 20 *Chapter 15:* Local equivalence of surfaces **(Homework 5 due)**

Wednesday, April 22 *Chapter 19:* The exponential map

Friday, April 24 *Chapter 19:* The exponential map and geodesics

Monday, April 27 *Chapter 19:* The exponential map and geodesics

Wednesday, April 29 *Chapter 19:* The exponential map and geodesics

Friday, May 1 *Chapter 21:* The Gauß–Bonnet Theorem

Monday, May 4 *Chapter 21:* Stokes' Theorem **(Homework 6 due)**

Wednesday, May 6 *Chapter 21:* The Gauß–Bonnet Theorem

Friday, May 8 *Chapter 21:* The Gauß–Bonnet Theorem

Wednesday, May 13 Final Exam due at 5:00 PM