

MATH 3968 Differential Geometry

Dr Emma Carberry

Second Semester, 2011

Course Information

Required Texts

- “Differential Geometry of Curves and Surfaces”, by Manfredo do Carmo, available at the student Co-op. (Our main text, and a classic.)
- “Lecture Notes for MATH 3968”, by Nigel O’Brien, available at KopyStop. (Mostly used for the exercises)

Recommended Texts

- “Elementary Differential Geometry”, by Andrew Crossley, on reserve at the library (more introductory than the main text)
- “Differential Forms and Applications”, by Manfredo do Carmo, on reserve at the library (for the latter part of the course)

Office Hours Carslaw 723 Tuesdays 2-3 p.m.

Assignments There will be two assignments, due at the beginning of class on Monday 12th September and on Monday 17th October respectively.

Website <http://www.maths.usyd.edu.au/u/UG/SM/MATH3968/>

Lecture Notes Notes for each lecture will be posted to the website. I will attempt to have these up by the lunchtime before each lecture, but no promises!

Expectations

Keep up to Date Look over your lecture notes as soon as possible after class, and definitely before the next lecture.

Do the Problems Mathematics is not a spectator sport. Doing problems is even more important than learning theory.

Ask Questions I don’t acknowledge the concept of a “stupid question”. Confused? Ask!

Tutorials

Each Tuesday afternoon tutorial will cover material from the 3 lectures of the previous week. Tutorials will run weeks 2-13.

Problems are classified as either *required* or *recommended*. You should have done your best to solve all of the required tutorial problems BEFORE coming to the tutorial and as many of the recommended problems as you have time for. If you can't solve some of the problems that is okay but come prepared to explain what you tried. At least one tutorial problem (could be required or recommended) will appear on the exam.

Assessment

Final Exam 75%

Assignments 20% There will be two assignments, worth 10% each

Participation in Tutorials 5% To maximise your participation grade:

- do your best to solve all the required tutorial problems before each class and as many of the recommended problems as you can.
- think through not only the solutions but how to explain them clearly.
- contribute to the tutorial discussion.

Objectives

This unit aims to give a hands-on introduction to differential geometry, in particular to

- introduce important notions such as curvature through the theory of curves and surfaces in 3-space
- motivate and introduce more abstract notions such as that of a manifold.

Outcomes

Students who successfully complete this unit should be able to:

1. describe and compute fundamental properties of a curve, such as curvature and torsion;
2. compute the mean and Gauss curvature of a surface in 3-space;
3. both describe geometrically what it means to differentiate “along a surface” and be able to compute this; in particular, to find geodesics on a given surface;
4. understand various ways in which calculus on flat spaces can be extended to calculus on curved spaces;
5. understand and use major theorems such as the Gauss-Bonnet theorem, that describe the global geometry of a surface in terms of its topology;
6. give examples of special types of surfaces, such as minimal surfaces, and analyse their properties;

7. work with abstract manifolds such as hyperbolic and projective spaces, and the generalisation of concepts such as covariant differentiation to these spaces;
8. define and compute integrals over manifolds.