# Mathematics 138A

# Introduction to Differential Geometry — I

## Course Notes

## Winter 2006

**Department of Mathematics**

**University of California, Riverside**

# Table of Contents


I. **Classical differential geometry of curves** ..... 1
- 0. Partial differentiation ..... 2
- 1. Cross products ..... 5
- 2. Parmetrized curves ..... 9
- 3. Arc length and reparametrization ..... 14
- 4. Curvature and torsion ..... 17
- 5. Frenet-Serret Formulas ..... 30

II. **Closed curves as boundaries** ..... 37
- 1. Differential forms ..... 37
- 2. Smooth mappings ..... 42
- 3. Inverse and implicit function theorems ..... 45
- 4. Congruence of geometric figures ..... 48

III. **Surfaces in 3-dimensional space** ..... 52
- 1. Mathematical descriptions of surfaces ..... 52
- 2. Parametrizations of surfaces ..... ??
- 3. Tangent planes ..... ??
- 4. The First Fundamental Form ..... ??
- 5. Surface area ..... ??
- 6. Curves as surface intersections ..... ??

IV. **Oriented surfaces** ..... ??
- 1. Normal directions and Gauss maps ..... ??
- 2. The Second Fundamental Form ..... ??
- 3. Quadratic forms and adjoint transformations ..... ??
- 4. Normal, Gaussian and mean curvature ..... ??
- 5. Special classes of surfaces ..... ??
- 6. Map projections ..... ??