# MATH 404 Introduction to Differential Geometry

1. Catalog Description

**MATH 404 Introduction to Differential Geometry** **4 units**

Prerequisite: MATH 304.

Theory of curves and surfaces in space. Topics such as Frenet formulas, curvature, geodesics, Cartan structural equations, Gauss-Bonnet Theorem. 4 lectures.

2. Required Background or Experience

Math 304.

3. Learning Outcomes

Students should:

a. Gain an understanding of the concepts of curve, surface, curvatures (principal, normal, Gaussian, mean), geodesics, covariant differentiation, Gauss map/shape operator, Gauss-Bonnet theorem.

4. Text and References

To be chosen by instructor. Suggested texts include:

- DoCarmo, Manfredo P., Differential Geometry of Curves and Surfaces
- O'Neill, Barrett, Elementary Differential Geometry
- Oprea, John, Differential Geometry and its Applications

5. Minimum Student Materials

Paper, pencils, and notebook.

6. Minimum University Facilities

Classroom with ample chalkboard space for class use.

7. Content and Method

a. Geometry of Curves
   1. The local theory of curves
   2. Frenet formulas
   3. Global theorems

b. Geometry of Surfaces
   1. The definition of the Gauss map/shape operator and their fundamental properties
   2. Normal, Principal, Gaussian and Mean curvatures
   3. Computational Techniques
   4. Cartan structural equations
   5. Isometries
   6. Gauss' Theorema Egregium
   7. Global theorems
   8. The Gauss-Bonnet theorem and its applications
   9. Parallel transport
   10. Geodesics
   11. Abstract Riemannian surfaces

8. Methods of Assessment

Comprehensive final exam, mid-term exams or quizzes, homework.