

Department of Mathematics & Statistics, KFUPM
Math 440 Differential Geometry
Syllabus (Semester 101)

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Course page: On WebCT at <https://webcourses.kfupm.edu.sa/>
Office Hours: To be announced in class

1. DESCRIPTION

Differential Geometry is the study of geometric questions by means of Calculus. This course introduces the study of curves and surfaces in Euclidean spaces.

- The geometry of curves involves the concept of torsion (the twisting out of a plane) and curvature (the bending away from a line).
- The geometry of surfaces involves the concepts of mean and Gaussian curvature (the bending away from a plane).

The main concepts we will study are

- Parameterization of curves and surfaces
- Frenet frames
- Curvature and torsion of space curves
- Geometry of surfaces
- Different types of curvatures of surfaces
- First and second fundamental forms
- Fundamental equations of surfaces, Fundamental theorem of surfaces
- Geodesics and some of their properties
- Isometries

These will also lay foundations to introduce the notion of abstract surfaces (2-dimensional manifolds) and manifolds at the end of the course.

2. TEXTBOOK

Differential Geometry and its Applications by John Oprea, The Mathematical Association of America, 2nd edition (2007).

3. TOPIC-WISE BREAK-UP

Week	Sec.	Topics
1	1.1	Introduction (The Geometry of Curves)
2 & 3	1.2	Arclength Parameterization
	1.3	Frenet Formulas
	1.4	Non-Unit Speed Curves
4	1.5	Some Implications of Curvature and Torsion
	1.7	The Geometry of Curves and Maple
5 & 6	2.1	Introduction (Surfaces)
	2.2	The Geometry of Surfaces
7	2.3	The Linear Algebra of Surfaces
	2.4	Normal Curvature
8	2.5	Surfaces and Maple
9	3.1	Introduction (Curvatures)
	3.2	Calculating Curvature
10	3.3	Surfaces of Revolution
	3.4	A Formula for Gauss Curvature
11		First and second fundamental forms Fundamental equations of surfaces Fundamental theorem of surfaces
12 & 13	5.1	Introduction (Geodesics, Metrics and Isometries)
	5.2	The Geodesic Equation and the Clairaut Relation
14 & 15		Isometries
		Introduction to Manifolds and Riemannian Geometry

4. SOFTWARE

The textbook contains sections where the notions of geometry of curves and surfaces are demonstrated (graphically & computationally) using the software Maple. We will use Maple mostly as a visual tool to understand the concepts intuitively. No prior knowledge of Maple is required.

5. GRADING

- **5%** Assignments/Homework, **10%** Quizzes, **10%** Project
- **20%** Major Exam 1 (Topics: 1.1 – 2.1)
- **20%** Major Exam 2 (Topics: 2.2 – 3.2)
- **35%** Final Exam

6. REFERENCE BOOKS

- Elementary Differential Geometry, by Andrew Pressley. Springer (2002).
- Diff. Geometry of Curves & Surfaces, by Manfredo Do Carmo.
- Modern Differential Geometry of Curves and Surfaces with Mathematica by A. Gray.