

**Tennessee Technological University  
Mathematics Department**

**MATH 4410/5410: Differential Geometry**

**I. COURSE DESCRIPTION FROM CATALOG:**

Geometry of curves and surfaces in three-dimensional space. Calculus on surfaces, curvature and Riemannian geometry. Lec. 3. Cr. 3.

**II. PREREQUISITE(S):**

C or better in MATH 2110, 2010 and 3400 (or consent of instructor for MATH 5410).

**II. COURSE OBJECTIVE(S):**

To study the different geometry of curves and surfaces both in its local and global aspects.

**IV. TOPICS TO BE COVERED:**

Local Curve Theory

- Basic Definitions and Examples
- Arc Length
- Curvature and the Frenet –Serret Theorem and Its Corollaries
- The Fundamental Existence and Uniqueness Theorem for Curves
- Non-Unit Speed Curves

Global Theory of Plane Curves

- Line Integrals and Green's Theorem
- The Rotation Index of a Plane Curve
- Convex Curves
- The Isoperimetric Inequality
- The Four-Vertex Theorem

Local Surface Theory

- Basic Definitions and Examples
- Surfaces
- The First Fundamental Form and Arc Length
- Normal Curvature, Geodesic Curvature, and Gauss's Formula
- Parallel Vector Fields along a Curve and Parallelism
- The Second Fundamental Form and the Weingarten Map
- Principal, Gaussian, Mean, and Normal Curvatures
- Riemannian Curvature and Gauss's Theorema Egregium
- Isometries and the Fundamental Theorem of Surfaces
- Surfaces of Constant Curvature

Global Theory of Surfaces

- Simple Curvature Results
- Geodesic Coordinate Patches
- Orientability and Angular Variation
- The Gauss-Bonnet Formula
- The Gauss-Bonnet Theorem and the Euler Characteristic
- The Theorems of Jacobi and Hadamard

Students with a disability requiring accommodations should contact the Office of Disability Services (ODS). 1  
An Accommodation Request (AR) should be completed as soon as possible, preferably by the end of the first week of the course. The ODS is located in the Roaden University Center, Room 112; phone 372-6119.

The Index of Vector Field

**V. ADDITIONAL INFORMATION:**

Graduate credit is earned on the basis of additional work required by the instructor per TTU Graduate Catalog.

**VI. POSSIBLE TEXTS AND REFERENCES:**

*Elements of Differential Geometry*, by Richard S. Millman and George D. Parker

*Differential Geometry of Curves and Surfaces*, by Manfredo P. Do Carmo

*Elementary Differential Geometry*, by Pressley

**VII. ANY TECHNOLOGY THAT MAY BE USED:**

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