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).

III.   COURSE OBJECTIVE(S):
To study the different geometry of curves and surfaces both in its local and global
aspects.

IV.   STUDENT LEARNING OUTCOMES:
On satisfying the requirements of this course, students will have the
knowledge and skills to:

1) Explain the concepts and language of differential geometry and its role in
modern mathematics: curves and surfaces, Gaussian and mean curvature,
geodesics; be able to state Theorema Egregium and the Gauss-Bonnet theorem.
2) Analyze and solve mathematical problems using appropriate techniques
from differential geometry
3) Apply problem-solving with differential geometry to diverse mathematical
contexts
4) Apply differential geometry techniques to specific problems in
mathematics or other fields

V.   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
The Index of Vector Field

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

VII.   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

VIII.   ANY TECHNOLOGY THAT MAY BE USED:

IX.   STUDENT ACADEMIC MISCONDUCT POLICY:
Maintaining high standards of academic integrity in every class at Tennessee Tech is critical to the reputation of Tennessee Tech, its students, alumni, and the employers of Tennessee Tech graduates. The Student Academic Misconduct Policy describes the definitions of academic misconduct and policies and procedures for addressing Academic Misconduct at Tennessee Tech. For details, view the Tennessee Tech's Policy 217 – Student Academic Misconduct at Policy Central.

X.   DISABILITY ACCOMMODATION:
Students with a disability requiring accommodations should contact the Accessible Education Center (AEC). An Accommodation Request (AR) should be completed as soon as possible, preferably by the end of the first week of the course. The AEC is located in the Roaden University Center, Room 112; phone 931-372-6119. For details, view the Tennessee Tech's Policy 340 – Services for Students with Disabilities at Policy Central.

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