



University of Nicosia, Cyprus

Course Code MATH-371	Course Title Differential Geometry	ECTS Credits 8
Department Computer Science	Semester Fall, Spring	Prerequisites MATH-270
Type of Course Required/Elective	Field Mathematics	Language of Instruction English
Level of Course 1 st Cycle	Year of Study 3 rd	Lecturer(s) Dr Marios A. Christou
Mode of Delivery Face-to-face	Work Placement N/A	Co-requisites None

Objectives of the Course:

The main objectives of the course are to:

- Provide students the concept of a curve in Differential Geometry and introduce them to special curves and to tangent, normal and osculating planes.
- Familiarize students with the concepts of principal normal and curvature, torsion and the Frenet formulas.
- Introduce students the theory of Surfaces, the First Fundamental form and the Contravariant and Covariant Vectors.
- Orient students to tensors and tensor calculus.
- Initiate students to the Second Fundamental form and the Gaussian and Mean Curvature.
- Introduce students to the Christoffel Symbols.
- Provide students with the fundamentals of Geodesic Curvature, Geodesics and introduce them to the Theorem of Gauss-Bonnet and its applications to Closed Surfaces .

Learning Outcomes:

After completing the course students are expected to be able to:

1. Explain the concepts of curves and surfaces.
2. Apply tangent, normal and osculating planes on surfaces.
3. Apply the tensor calculus to problems in physics and engineering.
4. Implement the concepts taught for problems in econometrics, digital signal processing and analyzing shapes.

Course Contents:

1. Introduction
 - Notation
 - Vectors
 - Basic rules of Vector Calculus
2. Theory of Curves
 - The concept of a curve in Differential Geometry
 - Special Curves
 - Arc Length
 - Tangent, Normal and Osculating planes
 - Principal normal and Curvature
 - Torsion
 - Frenet formulas
 - Vector of Darboux
3. Theory of Surfaces
 - Surface in Differential Geometry
 - Curves on a surface, Tangent plane
 - First Fundamental form and its properties
 - Contravariant and Covariant Vectors
 - Tensors and tensors calculus
 - Vectors in a Surface
 - Normal to a Surface
 - Length, Angle and Area
4. Gaussian and Mean Curvature of a Surface
 - Second Fundamental form
 - Sections on a Surface
 - Elliptic, Parabolic and Hyperbolic points on a Surface
 - Gaussian and Mean Curvature
 - Euler's theorem
 - Torus and Flat points
 - Christoffel Symbols
5. Geodesic Curvature and Geodesics
 - Geodesic Curvature
 - Geodesics
 - Geodesic Parallel and Polar Coordinates
 - Theorem of Gauss-Bonnet and applications to Closed Surfaces

Learning Activities and Teaching Methods:

Lectures, Handouts and Assignments

Assessment Methods:

2 Mid-Term Exams; Final Exam; Class Participation.

Required Textbooks/Reading:

Authors	Title	Publisher	Year	ISBN
Erwin Kreyszig	Differential Geometry	Dover	1991	0-486-66721-9

Recommended Textbooks/Reading:

Authors	Title	Publisher	Year	ISBN
Manfredo Do Carmo	Differential Geometry of Curves and Surfaces	Prentice Hall	1976	0-132-12589-7
Chuan-Chih Hsiung	A First Course in Differential Geometry	Wiley	1981	0-471-07953-7