MATH457/557

Differential Geometry

Course Outline

Topics	# of weeks
Chapter 1: Curves in the plane and in the space	0.5
Chapter 2: Curvature of a planar curve, curvature and torsion of a space curve, geometric interpretation of torsion, Frenet-Serret equations and their applications	1.5
Chapter 3: The Isoperimetric Inequality, the Four Vertex Theorem	0.5
Chapter 4: Surfaces in 3D: important examples, smooth surfaces and maps, tangent vector and space, derivative of a smooth map between surfaces, normals and orientability	1.0
Chapter 5: Classification of quadratic surfaces, ruled surface, surface of revolution, triply orthogonal systems, applications of the Inverse Function Theorem	1.5
Chapter 6: The first fundamental form of a surface, length and area on a surface, isometries of surfaces, conformal and equiareal mappings of surfaces, the Archimedes' Theorem	1.5
Chapters 7 and 8: Curvature of surfaces: the second fundamental form, the Gauss and Weingarten maps, the normal and geodesic curvatures, the Meusnier's Theorem, parallel transport and covariant derivative, Gauss equations, Gaussian, mean, and principal curvature, surfaces of constant Gaussian and mean curvature, flat surfaces	2.0
Chapter 9: Definition of geodesics and its basic properties, geodesic equations, geodesics on surfaces of revolution, geodesic coordinates	1.5
Chapter 10: The Codazzi-Mainardi equations, the Gauss' Theorem, surfaces of constant Gaussian curvature, geodesic mappings	1.5
Chapter 13: The Gauss-Bonnet Theorem (for simple closed curves, curvilinear polygons, and compact surfaces) and its applications, the Map Colouring Theorem, holonomy and Gaussian curvature, singularities of vector fields, critical points	1.5
Exams:	1.0

Textbook: Elementary Differential Geometry, 2nd edition by Andrew Pressley