1 Metric Space and Differential Geometry

1.1 Metric spaces

Metric spaces: Definition and examples. Open and closed balls, neighbourhood, open set, interior of a set. Limit point of a set, closed set, diameter of a set, subspaces, dense sets, separable spaces. Sequences in metric spaces, Cauchy sequences. Complete metric spaces, Cantor's theorem.

1.2 Compactness and Banach's fixed point theorem

Continuous mappings, sequential criterion and other characterizations of continuity. Uniform continuity. Connectedness, connected subsets of R. Compactness: Sequential compactness, Heine-Borel property, totally bounded spaces, finite intersection property, and continuous functions on compact sets. Homeomorphism. Contraction mappings. Banach fixed point theorem and its application to ordinary differential equation.

1.3 Curves

Tensor, Tensor algebra and calculus, curves in space and its parametric representation, arc length, intrinsic differentiation, parallel vector field, Tangent to a space curve, Serret-Frenet formulae, principal normal, binormal vectors, curvature, torsion, osculating plane, normal plane, rectifying plane, Helix, Bertrand curves , Fundamental theorem of space curve, curvilinear coordinate system in space.

1.4 Surfaces

Surfaces, Parametric representation of surfaces, curvilinear coordinates system on surface, first fundamental form of surface, Angle between two curves, Frenet formulas of surface, Geodesic curvature, Geodesic on surface, 2nd fundamental form, Gaussian Curvature, Developable surfaces, Tensor derivative, Weingarten formula, Gauss's formula, The equation of Gauss and Codazzi, mean curvature, Meusnier's Theorem, Principal curvature, Lines of curvature, Asymptotic lines, Gauss- Bonnet formula.