Abstract: This is a self contained mathematical introduction to General Relativity and the differential geometry required to understand it. General Relativity is the theory of gravity put forward by Albert Einstein in 1915. In this theory, the gravitational field is spacetime curvature, and energy-momentum is its source. This is the grandaddy of all field theories. In particular, all of the equations of modern particle physics were modeled after the Einstein equations—the equations that describe the evolution of spacetime curvature. The goal is to develop differential geometry and relativistic fluids in the mathematical language most efficient for understanding General Relativity. Topics will include: special relativity and Lorentzian geometry; The relativistic compressible Euler equations; Tensor analysis in coordinate notation, including contravariant, covariant indices and the Einstein summation convention; the Gravitational Metric Tensor, the metric Connection, Christoffel symbols, and the Riemann Curvature Tensor in Lorentzian spacetimes, and the derivation of the Einstein gravitational field equations as Einstein understood it. As time permits or as topics of extended study, we could include the Schwarzschild metric; Kruskal Coordinates and Black holes; the Oppenheimer-Volkoff equations and the Buckdahl Stability Limit for stars; the standard model of cosmology based on the Friedmann spacetime; and differential forms and integration theory. The class will end with seminar talks given by Instructor on his recent research, including the discovery that the Friedmann spacetime is unstable to spherical perturbations, and the discovery of a universal phase portrait that describes them.