The course is designed to extend beyond the third year fluid dynamics course which deals with subsonic incompressible flows to cover the supersonic, compressible flows, shock physics and associated research topics including inertial confinement fusion and high energy density physics.

As this is a new course and is still under development the following syllabus is a draft, but should give you an idea of the sort of material to be covered.

The approach will be to use supersonic flight as a way to introduce the concepts of shocks with hypersonics used to illustrate heat dissipation and induced changes in material properties. Mathematical models of shocks will then be introduced (Rankine-Hugoniot conditions, Hugoniot curves, isentropes etc). A treatment of shocks in solids then leads into a section on equation of state models including degeneracy, strong coupling, ionization dynamics etc. Methods of isentropic compression in planar and convergent geometries are described along with applications to materials science and planetary science. This leads into the use of convergent compressible flow theory in inertial confinement fusion. ICF is then used to illustrate the effects of dissipation on strong shocks in plasmas, including radiation losses and radiation transport. The effects of extreme pressures on the physics of dense plasmas will be illustrated by looking at the effects of degeneracy and Stark and Doppler broadening on the emission spectroscopy. ICF is also used to introduce the concepts of fluid instabilities such as the Rayleigh-Taylor and Kelvin-Helmholtz instabilities and these would in turn lead to treatment of turbulence. The role of alpha particles in igniting fusion experiments is used as an illustration of non-thermal energetic particles and leads to a discussion of particle acceleration processes in dense plasmas. A description of facilities required to achieve the high pressures required for ICF then leads into a section on dimensionless scaling of compressible hydrodynamics and how this allows these facilities to be used for laboratory astrophysics studies of stellar evolution.