Astronomy 202: Astrophysical Gas Dynamics

LL = *Fluid Mechanics* by Landau & Lifshitz
PP = *Plasma Physics* by Peter Sturrock
All other reading is Shu, *Physics of Astrophysics Vol II: Gas Dynamics*
You should start by reading the Feynman Lectures Vol II, Ch 40 & 41 for a nice introduction.

All non-Shu readings are available in the Astronomy Library – if not, check with me

1. Continuum vs. Particle Treatment (Ch. 1)
2. Equations of Gas Dynamics: neutral ideal fluids (LL Ch. 1; esp. §1,2,5,6,7,8,10; Shu Ch. 4)
3. Equations of Gas Dynamics: neutral viscous fluids (LL Ch. 2; esp §15,16; Shu Ch. 4)
4. Kinetic Theory Origin of Fluid Equations (Ch. 2 & 3)
5. Astrophysical Applications
   (a) Inviscid Flows: Vorticity, Bernoulli's Thm, Jets, Winds, & Bondi Accretion (Ch.6)
   (b) Viscous Flows: Accretion Disks (Ch. 7 + *Accretion Disks in Astrophysics*, Pringle, 1981, ARA&A, 19, 137; Pringle's article is a good, brief, intro to accretion theory. The discussion of viscosity mechanisms is, however, outdated. Another source of accretion disk readings is *Accretion Power in Astrophysics* by Frank, King, & Raine)
   (c) Linear Perturbation Theory: Stellar Oscillations, Spiral Density Waves, & Hydrodynamic Instabilities (Ch. 8, 11, 12)
   (d) Turbulence: Seeing, Scintillation, ... (Ch. 9)
   (e) Mixing Length Theory of Convection (Ch. 10)
   (f) Shocks, Blast Waves, & SN Remnants (Ch. 15 & 17)
6. The Motion of Charged Particles in Plasmas (PP: Ch. 1-5 would be good; 1-3 necessary)
7. Magnetohydrodynamics: the dynamics of ionized conducting fluids (Ch. 21)
8. Astrophysical Applications
   (a) MHD waves (Ch. 22)
   (b) The Parker and Magnetorotational Instabilities (23; Balbus, 2003, ARA&A, 41, 555)
   (c) MHD winds & spin down: stars & jets (Spruit; astro-ph/9602022)