(AST 462) Physics of Astrophysics 2: Astrophysical Fluid and Plasma Dynamics

Professor: Eric Blackman, B&L 417A, 5-0537

Texts: A. Choudhuri, Physics of Fluids and Plasmas (Required); F. Shu, Gas Dynamics (Recommended),

Course grading: course will be graded pass-fail

Course work:

The only graded work in this course will be a final exam graded pass with distinction, pass, or fail. This system is a version of the “Cambridge University” model for courses.

1. Study class notes and text
2. Practice problems as needed (not graded)
3. Make a table of contents for the course notes to guide study.
4. Final exam (only graded work) based on class notes

Tentative Physics Topics Outline: (Astrophys. applications will be discussed in context)

Neutral Fluids

Kinetic theory vs. Fluids: the big picture
Boltzmann equation and collisions
Transport Theory
Moment Equations/Basic Fluid Equations
Hydrostatic Equilibrium Limit
Bernoulli’s Principle
Vorticity and Circulation
Inviscid vs. Viscous Flows
Sound Waves
Spiral Density Waves
Fluid Instabilities
Shocks
Thermal Instability
Hydrodynamic Turbulence
Mixing Length Theory of Convection
Rotating Fluids
Accretion Disks
Outflows

Magnetohydrodynamics, Plasmas and Related Phenomena

Basic Plasma Physics
Basics of MHD and relation to hydrodynamics
Flux Freezing
Magnetic Breaking
MHD Outflows
Magnetic Dynamos
MHD Turbulence
MHD Stability
Magneto-rotational Instability and Accretion Disks