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

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

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

Course grading: course will be graded pass-fail

Course work:

1. Study notes/text (notes handed out for each lecture)

2. Several Problem Sets

3. Project for Class Presentation: These presentations will be 1/2 hour to 45 minutes on astrophysical phenomena or processes that involve fluid or plasma dynamics. (This means almost anything in astrophysics actually!)

BUT: I would like for you to use the course project as an opportunity that allows you to look in more depth at an aspect of your research that you might not have otherwise pursued, a new research problem, or a topic you would like to learn about at the research level.

In this respect, keeping the topic narrow enough to pursue in depth will be the suggested style this term. To facilitate this, I would like you to have chosen your topics by **March 15th** and I will help you choose your topics.

The outcome of the project will be a talk presented in class. You can use blackboard, view graphs, power-point etc as desired. The notes or the view graphs should be handed in afterward.

4. Make your own table of contents for the course notes at the end. Knowing myself, I suspect the path will deviate somewhat from the initial outline below. The small exercise of making a table of contents will induce you to unify the train of thought that emerged and organize the notes for possible future purposes.

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