

# Plasma Physics I - PHYS 6330

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**Class:** 9:00 - 10:15 TR, SER 122

**Semester:** Spring 2020

**Office Hours:** TR 10:15-11:15 or by appointment

## Course Objectives

Develop an understanding of the plasma state including single particle motion, waves in a cold plasma, plasma fluid and kinetic equations, and magnetohydrodynamics.

## Syllabus

### Plasma descriptions and parameters

1. Particle, kinetic, and fluid descriptions of a plasma
2. Density, temperature, Debye length, the plasma parameter
3. Plasma sheaths, plasma frequency, cyclotron frequency
4. Collision frequency, coupling parameter, collective behavior

### Single particle motions

1. Motion in a static uniform  $\mathbf{E}$  and  $\mathbf{B}$  field
2. Gradient and curvature drifts
3. Motion in a magnetic mirror field
4. Polarization drift, ponderomotive force
5. Adiabatic invariants
6. Hamiltonian method

### Waves in a cold plasma

1. Fourier representation and dispersion relation
2. Waves in a cold uniform unmagnetized plasma
3. Waves in a cold uniform magnetized plasma
4. Parallel, perpendicular, and oblique wave propagations

### Kinetic theory and moment equations

1. Distribution function and kinetic equation
2. Moment equations and closure problem
3. Electron and ion pressure waves
4. Collisional drag force

### Magnetohydrodynamics (MHD)

1. Basic equations
2. Magnetic field convection and diffusion
3. Ideal MHD
4. MHD waves

### MHD equilibria and stability (optional)

1. Magneto-static equilibria
2. MHD stability and instabilities
3. Resistive instabilities

## Text

Lecture Notes based on D. A. Gurnett and A. Bhattacharjee, *Introduction to Plasma Physics*, 2nd ed. (Cambridge University Press, 2017)

**Grading**

Homework (4 sets) 40%, Midterm (February 25) 30%, Final (April 23) 30%

For the homework sets and midterm, if you got a wrong answer and lost points you have a second chance of getting 50% of the points by handing in the corrected answer or coming to my office to show your understanding (preferred).

100-90% A, 89-85% A-, 84-80% B+, 79-75% B, 74-70% B-,  
69-60% C+, 59-50% C, 49-40% C-, 39-30% D+, 29-20% D, 19-10% D-, 9-0% F

**Disability Resource Center**

HUSU welcomes students with disabilities. If you have, or suspect you may have, a physical, mental health, or learning disability that may require accommodations in this course, please contact the Disability Resource Center (DRC) as early in the semester as possible (University Inn # 101, 435-797-2444, [drc@usu.edu](mailto:drc@usu.edu)). All disability related accommodations must be approved by the DRC. Once approved, the DRC will coordinate with faculty to provide accommodations.

**Honor Code**

The honor code will be strictly enforced in this course. Any suspected violations of the honor code will be promptly reported to the honor system. For more information please visit:  
<http://studentconduct.usu.edu/studentcode/article6>.