Plasma Physics I - PHYS 6330

Instructor: Jeong-Young Ji (email: j.ji@usu.edu office: SER230 phone: 797-8118)
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 E and 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
HUUS 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). 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: