

Physics 928 — Introduction to Plasma Physics

Spring 2023

Meeting Time

Meeting time: 12:30 – 1:45 PM, Tuesday & Thursday, Jorgensen Hall, Room 145

Instructor

Brad Shadwick, 310N Jorgensen Hall, 472-3578, shadwick@unl.edu
Office Hours: Drop by or by appointment.

Text

There is no formal textbook for this course. Useful references include:

- Hans L. Pécseli, *Waves and Oscillations in Plasmas*. Available [electronically](#) from the UNL library.
- R. D. Hazeltine and F. L. Waelbroeck, *The Framework of Plasma Physics* Perseus Books 1998.
- S. Ichimaru, *Basic Principles of Plasma Physics: A Statistical Approach*, Benjamin 1973. Available [electronically](#) from the UNL library.

These references will be put on reserve in the Engineering library.

Prerequisites

Physics 911 & 913. We will draw extensively on the concepts from Mechanics and Electromagnetism.

Course Outline

This course will cover basic plasma physics and an introduction to laser-plasma interactions for accelerator applications. We will not discuss magnetic fusion or plasma processing.

Topics to be covered (approximate):

I. Basic Plasma Physics

- 1) Nature of Plasmas
- 2) Relativistic Particle Dynamics
- 3) Fluid Models
- 4) Waves & Dispersion Relations
- 5) Kinetic Plasmas

II. Laser-Plasma Interactions

- 1) Single-Particle Dynamics
- 2) Wakefield Generation
- 3) Wave Breaking
- 4) Particle Trapping
- 5) Laser Guiding

- 6) Accelerator Applications
- 7) Raman Processes

Homework

Mastering the concepts covered in this course requires solving problems. The importance of doing and fully understanding the homework problems cannot be over emphasized. Homework will be throughout the semester and will be due approximately one week later. While discussing homework problems with other students is encouraged, the work you turn must be yours alone. In your solutions, you **must state** all sources (people, web sites, books, *etc.*) from which you obtained part or all of a solution.

Simulation Labs

A number of homework problems will involve using various computer codes to perform numerical simulations of a range of plasma phenomena. The codes will be available on the web; details to provided still being worked out.

Exams

There will be one mid-term exam held Thursday, March 23 from 7:00 to 9:00 PM. The final will be a take-home exam.

Grading

- 1/3 Final exam
- 1/3 Mid-term exam
- 1/3 Homework

Web Pages

Course materials will be available through the Canvas.

UNL Course Policies

Students are responsible for knowing the university policies found at <https://go.unl.edu/coursepolicies>.