

SYLLABUS: PHYSICS 8120

PLASMA PHYSICS

SPRING 2005

Instructor: **Prof. Paul J. Wiita**

Class Timings: Tuesdays and Thursdays 11:00 AM –12:15 PM

First class, Tuesday, Jan. 11th, 2005; last class, Thursday, April 28th.

Room: Changed to **732 One Park Place**.

Contacts: 715 One Park Place;

Preferred, via e-mail at: wiita@chara.gsu.edu.

Phone: (404)651-1367; home: Atlanta (609)273-7177.

Princeton office (most Fridays): (609)258-1164; Princeton home (most weekends): (609)683-3834.

Office hours: Mondays, 10–11 AM, Tuesdays 1:30–2:30 PM, Wednesdays, 10–11 AM. If you can't come during one of these scheduled times, please make an appointment to see me at some other time.

Required Text:

Vinod Krishan, **Astrophysical Plasmas and Fluids** (Kluwer Academic Publishers, paperback); this is a reasonably up-to-date (1999) text written at an appropriate level.

Other texts to which you may wish to refer:

- 1) Peter A. Sturrock, **Plasma Physics**
- 2) Nicholas A. Krall & Alvin W. Trivelpiece, **Principles of Plasma Physics**
- 3) Lyman Spitzer, Jr., **Physics of Fully Ionized Gases**
- 4) George B. Rybicki & Alan P. Lightman, **Radiative Processes in Astrophysics**

COURSE OBJECTIVES: This course will provide a high level introduction to the physics of the bulk of the known matter in the universe, a.k.a., the plasma state. We will begin with a discussion of the huge ranges of densities and temperatures at which plasmas are found on earth and in space. We next turn to a detailed description of how particles move in EM fields. Familiarity with electromagnetic waves in vacuum and neutral gases is assumed, so we will concentrate on the many types of additional waves which can be excited in an ionized gas. Plasmas are subject to a wide range of unstable fluctuations which can have interesting (and even devastating) consequences; we will study a small fraction of these instabilities. The ways in which heat, momentum and other properties are transported through plasmas will receive some attention. The last third of the course will be devoted to applications of plasma physics in astrophysics.

COURSE SCHEDULE

| TOPIC | # of Lectures |
|-------------------------------------------------------|---------------|
| Nature of Plasmas on Earth and in Space | 2 |
| Motion of Charged Particles in Electromagnetic Fields | 3 |
| Waves in Plasmas | 5 |
| Instabilities in Plasmas | 4 |
| Midterm Exam (probable date, 1 March) | 1 |
| Transport Processes | 5 |
| Radio Galaxies: Synchrotron Emission | 3 |
| Solar Corona: Reconnection and Particle Acceleration | 3 |
| Pulsars: Coherent Emission | 3 |
| Final Examination: Due Thursday, April 28th, 11 AM. | |

Of course, modifications to the above schedule may be necessary.

SOME USEFUL INFORMATION:

This syllabus and all assignments will be posted on my web-site:

www.chara.gsu.edu/~wiita/teaching.html

I plan to post the notes to that site, most likely within a day or two after the lecture in which they are presented. Thus, if you have too much difficulty in simultaneously taking notes and understanding the material being presented, you should concentrate on the latter and then download the notes later to go over them at your leisure. But you will be wise to take notes on material that is not presented on overheads, since that stuff is unlikely to be posted on the web-site. (Of course you can always make friends with a good note taker and copy her notes.)

RESPONSIBILITIES AND GRADING:

The assignments will consist of 3 or 4 problems per week, usually grouped into bi-weekly problem sets. At least one assignment will involve a computer project, and at least one will incorporate a short written paper. There will be an in-class, closed book, midterm exam accounting for 25% of the course grade. The assignments will account for 50%, while the take-home final exam will comprise the other 25% of the course grade.

Students are expected to abide by the Policy on Academic Honesty (see the **Graduate Bulletin**). In particular, unless explicitly instructed otherwise, there is to be no collaboration on assignments; only by working the problems by yourself are you likely to learn this material.

All questions concerning assignments are to be directed to me, unless I let you know that working together is acceptable on a particular assignment or part thereof.

This syllabus may be revised if necessary.