

PHYSICS 783 – Plasma Kinetic Theory

CLASS DETAILS:

- Meeting Times: MWF, 10:30-11:20am Rm 222 Hodges Hall
- Course Web Site: <http://ulysses.phys.wvu.edu/~pcassak/phys783.html>
- Instructor: Dr. Paul Cassak Rm 107 Hodges Hall
- Contact Info: pcassak@mix.wvu.edu (304) 293-3422, ext. 1458

OFFICE HOURS:

- In Room 107 of Hodges Hall unless announced otherwise.
- Monday 4-5pm, Thursday 2-3pm + by appointment + whenever the door is open
- Please come by for help with concepts, homework, or other advice!

PREREQUISITES:

- Catalog says – PHYS 481 (Intro Plasma) & PHYS 631 (Graduate Classical Mechanics) & PHYS 634 (Graduate Electricity & Magnetism)
- Also important – Laplace Transforms, Contour integration

COURSE OBJECTIVES:

This course covers kinetic theory in the context of plasma physics at a graduate level. The objective of this course is to develop a deep understanding of techniques of kinetic theory used in plasma physics. The goal is to be able to pick up a paper that uses kinetic theory and have the ability to work through and understand it.

- The topics to be covered are: (from the graduate catalog) the Vlasov equation, quasilinear theory, nonlinear phenomena, plasma waves and instabilities, Landau damping and finite-Larmor-radius effects

EXPECTED LEARNING OUTCOMES:

Upon successful completion of this course, you will:

- 1) have developed a deep understanding of kinetic theory.
- 2) be proficient with the analytical tools of kinetic theory.
- 3) be comfortable applying the techniques of kinetic theory to physical systems.
- 4) have developed a breadth of knowledge about how kinetic theory is used.

TEXTBOOK:

Fundamentals of Plasma Physics, Paul M. Bellan

OTHER BOOKS OF INTEREST:

- *The Physics of Fluids and Plasmas, An Introduction for Astrophysicists*, Arnab Rai Choudhuri ****EXCELLENT****
- *Introduction to Plasma Physics*, R. J. Goldston and P. H. Rutherford ****GOOD**** (on reserve at downtown library)
- *The Physics of Plasmas*, R. Fitzpatrick
<http://farside.ph.utexas.edu/teaching/plasma/plasma.html> ****FREE****
- There are *a lot* of older, harder to find, books that cover kinetic theory in great detail.

CLASS EXPECTATIONS:

- Your focus should be on physical understanding, not rote memorization.
- It is expected that you will put forth a sincere effort into learning.
- It is expected that you will *read the book before class*.
- This course should be treated as “guided independent study.” Do not expect that attendance is sufficient or lectures are complete. Important topics will be left out!
- It is expected that you will be considerate of your fellow classmates and myself – I will turn my cell phone ringer off, too.

HOMEWORK:

- Homework problems will be given approximately weekly to bi-weekly and are intended to challenge you beyond mere regurgitation. Problems are not chosen randomly – they often cover topics that would be covered in class if time allowed!
- If you’re stuck on homework, talk to your classmates or come see me for help!

COLLABORATION POLICY:

Science is fundamentally a collaborative endeavor. It is very rare in the modern world for someone to sit alone in a room and make important contributions to science. As such, working together on homework is encouraged! However, an important balance must be reached. Copying someone else’s solution is not allowed in science, nor will it be allowed in this class. An appropriate technique is to try the homework on your own first, then discuss it with your classmates, then try again on your own.

- To approach the way science is really done, please include a list of collaborators and references used for the homework (other than Bellan or class notes) at the top of your homework. This list will have no bearing on your grade.

EXAMS:

There will be no formal exams in this course.

PROJECT:

For a project, you will choose a publication in the literature that uses kinetic theory and write up a summary of the paper. The paper can be related to your own research, but need not be. The write-up should be in your own words and be on the order of 3-5 pages. It should be written at a level appropriate for a graduate student.

GRADING BREAKDOWN AND SCHEME:

Your grade will be based on homework (75%), the project (20%), and class participation (5%). There will be approximately 12 assignments. The homework grading will be weighted to make more time consuming assignments worth more points. Grades will be awarded roughly as follows:

A	100-90%
B	90-80%
C	80-70%
D	70-60%

Some regard will be paid to natural breaks in the grade distribution. I reserve the right to adjust grade scales (*i.e.*, curve) in the interest of fairness and propriety if warranted.

GRADING POLICIES:

- Homework is due at the beginning of class. Late homework will be graded by the same standards as on-time homework, but there is a penalty for lateness of 50%.
 - If you don't finish on time, submit what you have and turn the rest in late!
- Partial credit is awarded, so develop your ideas logically. Show your work (credit is given for the process, not the solution!) and draw sketches where appropriate.
- Take pride in your work. If your solution is illegible, I can't give credit.
- Grading appeals must be made within one week of when the submission is returned.

SOCIAL JUSTICE STATEMENT:

WVU policy – “West Virginia University is committed to social justice. I concur with that commitment and expect to maintain a positive learning environment based upon open communication, mutual respect, and nondiscrimination. Our University does not discriminate on the basis of race, sex, age, disability, veteran status, religion, sexual orientation, color or national origin. Any suggestions as to how to further such a positive and open environment in this class will be appreciated and given serious consideration.

“If you are a person with a disability and anticipate needing any type of accommodation in order to participate in this class, please advise me and make appropriate arrangements with Disability Services (304-293-6700).” The University has many programs in place. Please let me know if I can be of any assistance, and do so with sufficient notice.

ACADEMIC INTEGRITY STATEMENT:

WVU policy – “The integrity of the classes offered by any academic institution solidifies the foundation of its mission and cannot be sacrificed to expediency, ignorance, or blatant fraud. Therefore, I will enforce rigorous standards of academic integrity in all aspects and assignments of this course. For the detailed policy of West Virginia University regarding the definitions of acts considered to fall under academic dishonesty and possible ensuing sanctions, please see the Student Conduct Code at <http://www.arc.wvu.edu/admissions/integrity.html>. Should you have any questions about possibly improper research citations or references, or any other activity that may be interpreted as an attempt at academic dishonesty, please see me *before* the assignment is due to discuss the matter.”