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NE/PY 529, All Sections, Course Syllabus

Plasma Physics and Fusion Energy II

Spring 2024

Instructor Information

Name	Office Phone	Email	Office Location
Amanda M. Lietz 	(919)515-3658	alietz@ncsu.edu	Burlington Laboratory 3146

Office Hours

In person office hours Mondays, immediately after class, 11:45am-12:45pm in BL 3146. In the event of holidays or rescheduling, these are visible publicly on my google calendar. Scheduled office hours should be used to the maximum extent possible, but reasonable requests for appointments are also available.

Virtual office hours are available by appointment for distance education students.

Preferred Method of Communication & Response Time

- **Preferred method of communication:** If you need to contact me directly, my preferred method of communication is email. If I email you directly, please strive to respond within two business days. It is recommended that you check your NC State email at least once a day to stay on top of course communications.
- **Asking questions about the course:** If you have a question about the course or its content that may be of interest to others, please post your question on the Student Help Forum in Moodle. You can expect to receive a response within two business days.
- **Email guidelines:** Please include NE 529 in the subject of your email.

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Course Information

Course Website: [Moodle](#)

Meeting Time and Location: Mondays and Wednesdays, 10:15-11:30, 331 Lampe

Course Credit Hours: 3.0

Catalog Description

This course expands on the treatment of plasmas as a system of coupled fluids and introduces the foundations of plasma kinetic theory. Derivation of the plasma kinetic equation and the Vlasov equation serve as the starting point to introduce the kinetic study of plasma systems. From this introduction of the governing equations for full kinetic treatment, methods for analyzing plasma response to electromagnetic and electrostatic perturbations using the linearized Vlasov model for uncorrelated plasmas are introduced. Kinetic stability of Vlasov plasmas is introduced and the Nyquist method is used to determine conditions for kinetic stability. The concept of correlated plasmas is then introduced through the introduction of reduced distribution functions and the BBGKY hierarchy. Finally, simple correlated systems and the Liouville model for two-system correlation is covered to look at the impact of particle correlation due to collisions and coulomb interaction.

Structure

Sec. 001: The majority of this course is **synchronous**, delivered through real-time, face-to-face class sessions. Additional materials and activities delivered through **Moodle**, a secure and easy-to-use online learning platform.

Sec. 601 (distance education): This course is completely **asynchronous**, which means that students have no real-time class meeting requirements. Asynchronous components are delivered through **Moodle**, a secure and easy-to-use online learning platform. Lectures may be viewed synchronously or asynchronously via Panopto (link in Moodle).

Learning activities in this course will include lectures, in-lecture activities (or Moodle forums), reading assignments, weekly homework, and written exams. At least one assignment will include running a computational model.

The topic outline and assignment schedule can be found in the "Course Outline" on Moodle. This is subject to change.

Meeting Time and Tool Used

Sec. 001: Lecture is in person Mondays and Wednesdays 10:15-11:30pm in 331 Lampe. In the event of illness, lectures recorded on Panopto are also available.

Sec. 601 (distance education): No in-person/synchronous meetings are required for this course. A link for synchronous meetings may be provided, but recordings will always be available in Panopto.

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Prerequisites/Corequisites

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Electromagnetics

Minimum Technical and Digital Information Literacy Skills

Required technical Skills

- Navigate and use Moodle, NC State's Learning Management System.
- Use Gmail, including attaching files to email messages.
- Navigate and use Gradescope to submit assignments (links within Moodle).
- Download and install software as needed (see [section on required software](#))
- Use web conferencing tools including Zoom and Google Meet.
- Post to discussion boards and forums

Required digital information literacy skills

- Use computer networks to locate and store files or data.

General Education Program (GEP) Information

GEP Category Fulfilled

None

GEP Corequisites

None

Learning Outcomes

Upon completion of this course, students will be able to:

1. Obtain a working knowledge of the formulation of plasma kinetic equations
2. Evaluate plasma interaction with electromagnetic and electrostatic perturbations using the linearized Vlasov equations
3. Evaluate plasma stability conditions using Nyquist methods and linear kinetic stability criteria
4. Obtain a working knowledge of the BBGKY hierarchy and governing equations for correlated plasma systems
5. Obtain a working knowledge of first order correlated plasma systems using the Liouville formulation of the truncated BBGKY hierarchy

Course Materials

Required textbook

Paul M. Bellan, "Fundamentals of Plasma Physics", (2008) Any Edition

- Cost: ~\$100 paperback; free eBook through NCSU libraries

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- Purpose: background reading and as reference material for solving homework problems. Exams are closed-book, so no physical copy is required.

Other required materials

None

Optional materials

Dwight R. Nicholson, "Introduction to Plasma Theory", (1992) Any Edition

- Cost: ~\$60 hardcover
- Purpose: background reading and as reference material for solving homework problems.
- This book is out of print, so may be difficult to find, but is very useful so you may find it worth it.

Technology Requirements

NC State University Libraries offers [Technology Lending](#), where many devices are available to borrow for a 7-day period. [Computer labs](#) are available in various locations around campus for student use.

Computer

Access to a Windows computer to run [Bolsig+](#). This will only be required for 1 or 2 homework problems.

Other devices

n/a

Software and digitally-hosted course components

The following software and tools will be used in this course. Some tools are a part of NC State's enterprise tools. See [information about their purpose, how to access them, accessibility information, and privacy policies](#). The same information for any other tools required in this course is provided in the list below.

- Moodle
- Gradscope
- Panopto
- Gradescope
- Adobe Reader (or any pdf software to provide submissions to Gradescope).

Other Student Expenses

- n/a

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Communication Guidelines

This course has been significantly modified since I last taught it, and your feedback is vital. You are strongly encouraged to use the anonymous **suggestion box on the Moodle site** for anything from small corrections to the topics of focus in the course. Even if you do not require anonymity, it will be helpful to have the feedback compiled in one place.

Respecting our learning community

The [NC State Code of Student Conduct](#) outlines expectations for behavior in the classroom (whether virtual or physical) and the consequences for students who violate these expectations. Any behavior that impacts other students' ability to learn and succeed will be addressed, but expressing diverse viewpoints and interpretations of course content is welcome.

Community guidelines for this course include:

- Use a respectful tone in all forms of communication (email, written, oral, visual)
- Maintain professionalism (avoid slang, poor grammar, etc.) in your written communication.
- Respect regional dialects and culturally embedded ways of oral communication.
- Stay home or in your dorm room if you are exhibiting symptoms of a contagious illness (fever, chills, etc.).
- Enter our virtual and/or physical classroom community respectfully by refraining from lewd or indecent speech or behavior, helping to maintain a safe physical environment, not using your cell phone for voice or text communication except when explicitly given leave to do so, and not attending class under the influence of any substance.
- Treat each community member with respect by not recording others without their consent or engaging in any form of hazing, harassment, intimidation, or abuse.
- Respect cultural differences that may influence communication styles and needs.

Plan for interaction between instructors and students

This course has been significantly modified since I last taught it, and your feedback is vital. You are strongly encouraged to use the anonymous **course suggestion box on the Moodle site** for anything from small corrections to the topics of focus in the course. Even if you do not require anonymity, it will be helpful to have the feedback compiled in one place. It also gives me the opportunity to review your feedback again later in the semester. With each homework assignment, there is also an anonymous survey regarding the time required to complete it.

Feedback from the instructor to the students on specific assignments can be found via Moodle/Gradescope.

Expectations for learner participation and interaction

Some course activities including synchronous class sessions, Moodle Forums, will require you to interact with other students in the course. Communication expectations are detailed in the information about each assignment or activity.

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Grading and Feedback

Grading criteria, details, and timing of feedback

Percentage of grade	Component	Details and timing of feedback
45 %	Homework	<ul style="list-style-type: none">• Approximately 11 homework assignments are due no more than once per week. The length of these assignments may vary significantly.• The number of assignments may be reduced as low as 9 based on the pace of instruction.• Each problem will be labeled with a point value.• <i>You will receive a grade within 1 weeks of the due date.*</i>
20 %	Midterm Exam	<ul style="list-style-type: none">• Exams are closed book, in class. You will be provided an equation sheet. You may also use a graphing or scientific calculator. NO collaboration or devices that access the internet are allowed.• <i>You will receive a grade within 2 weeks of the Midterm date.*</i>
30 %	Final Exam	<ul style="list-style-type: none">• Note that the final exam is NOT at the normal class time.• Exams are closed book, in class. You will be provided an equation sheet. You may also use a graphing or scientific calculator. NO collaboration or devices that access the internet are allowed.• <i>You will receive a grade by the end of the semester.*</i>
5 %	Participation	<ul style="list-style-type: none">• Asking questions in class, sharing from group discussions or individual assignments, and posts in the lecture-activities forum all constitute participation.• Negligible (<10) instances of participation will receive partial credit.• No instances of participation will receive 0 credit.• <i>You will receive a grade before the final exam*</i>

*modifications to the timing of grades/feedback, if required, will be announced in class or via email.

Grading scale

This course uses the following (non-standard) grading scale:

Low	Letter	High
95 ≤	A+	≤ 100

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90 ≤	A	< 95
85 ≤	A-	< 90
80 ≤	B+	< 85
76 ≤	B	< 80
72 ≤	B-	< 76
68 ≤	C+	< 72
64 ≤	C	< 68
60 ≤	C-	< 64
56 ≤	D+	< 60
52 ≤	D	< 56
48 ≤	D-	< 52
0 ≤	F	< 48

Requirements for earning a grade of “Satisfactory”

If you are taking this course for credit only (S/U), your grade will be reported as S (Satisfactory) when coursework is equivalent to a C- or better or U (Unsatisfactory) when coursework is equivalent to less than a C-. For more information, see the [Credit Only Courses regulation](#).

Requirements and procedures for auditing this course

Auditing this course is approved on a case-by-case basis. Please contact the course instructor to attain approval. Refer to the [Audit regulation](#) for more information and links to required forms.

Course Schedule

The schedule is available in the ‘Course outline’ document in Moodle. Please note: the course schedule is subject to change.

Midterm Exam – 75 Minutes.

Sec. 001: 3/4/2024, 10:30-11:45am, Lampe 331

Sec. 601: Open 3/3/2024-3/5/2024. If you have a conflict in this window, contact the instructor BEFORE the week of the exam.

Final Exam – 2.5 hours.

Sec. 001: 4/29/2024, 8:30-11:00am, Lampe 331

Sec. 601: Open 4/28/2024-4/30/2024. If you have a conflict in this window, contact the instructor BEFORE the week of the exam.

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Course Policies

Proctored exams

Sec. 001: Exams are in the normal lecture room and proctored by the Instructor.

Sec. 601 (Distance Education): Exams must be proctored according to instructions and procedures from the Engineering Online Office.

Late assignments

Homework assignments will be accepted with a 10% penalty up to 7 days past the original due date. Assignments submitted later than 7 days past the original due date will NOT be accepted.

For excused absences (illness, family emergencies, etc.) please email the instructor. If you have a known conflict which will likely require an extension (e.g. conference travel), you should request an extension in advance of the deadline.

Incomplete grades, withdrawals

Information on incomplete grades can be found at [REG 02.50.03 – Grades and Grade Point Average](#). If you encounter a serious disruption to your work not caused by you and you would have otherwise successfully completed the course, contact your instructor as soon as you can to discuss the possibility of earning an incomplete in the course for the semester, including an agreement on when the remaining work must be done in order to change the grade to the appropriate letter grade.

If your student must withdraw from a course or from the University due to hardship beyond their control, see [Withdrawal Process and Timeline | Student Services Center](#) for information and instructions.

Attendance

Attendance will not be taken, but is strongly encouraged to maximize your opportunity for participation.

Related NC State Policy: [REG 02.20.03 – Attendance Regulations](#)

University Policies

Academic integrity and honesty

Students are required to comply with the university policy on academic integrity found in the [Code of Student Conduct 11.35.01 sections 8 and 9](#). Therefore, students are required to uphold the Pack Pledge: "I have neither given nor received unauthorized aid on this test or assignment." Violations of academic integrity will be handled in accordance with the [Student Discipline Procedures](#).

Please refer to the [Academic Integrity](#) web page for a detailed explanation of the University's policies on academic integrity and some of the common understandings related to those policies.

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Collaboration

Verbal communication among students on homework is encouraged. However, the work you turn in should be your own. Direct copying/sharing of answers is prohibited.

The work you turn in should be your own, and presenting AI-generated content as your own work is prohibited. Using AI resources as a reference material is permitted.

Student privacy

Originality Checking Software

Software is not used in this course to detect the originality of student submissions.

Class recording statement:

In-class sessions are recorded in such a way that might also record students in this course. These recordings MAY be used beyond the current semester or in any other setting outside of the course. Contact your instructor if you have concerns.

Class privacy statement:

This course requires online exchanges among students and the instructor, but NOT with persons outside the course. Students may be required to disclose personally identifiable information to other students in the course, via electronic tools like email or web postings, where relevant to the course. Examples include online discussions of class topics and posting of student coursework. All students are expected to respect the privacy of each other by not sharing or using such information outside the course.

Other Policies

Students are responsible for reviewing the NC State University PRR's which pertain to their course rights and responsibilities:

- [Equal Opportunity and Non-Discrimination Policy Statement](#) and [additional references](#)
- [Code of Student Conduct](#)
- [Grades and Grade Point Average](#)
- [Credit-Only Courses](#)
- [Audits](#)

Student Resources

Academic and Student Affairs maintains a website with links for student support on campus, including academic support, community support, health and wellness, financial hardship or insecurity, and more. [Find Help on Campus.](#)

Disability resources

Reasonable accommodations will be made for students with verifiable disabilities. In order to take advantage of available accommodations, students must register with the [Disability Resource Office](#)

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(DRO). For more information on NC State's policy on working with students with disabilities, please see the [Policies, Rules and Regulations page maintained by the DRO](#) and [REG 02.20.01 Academic Accommodations for Students with Disabilities](#).

Safe at NC State

At NC State, we take the health and safety of students, faculty and staff seriously. The [Office for Institutional Equity and Diversity](#) supports the university community by providing services and resources to support and guide individuals in obtaining the help they need. See the [Safe at NC State webpage](#) for resources.

Supporting Fellow Students in Distress

As members of the NC State Wolfpack community, we each share a personal responsibility to express concern for one another and to ensure that this classroom and the campus as a whole remain a healthy and safe environment for learning. Occasionally, you may come across a fellow classmate whose personal behavior concerns or worries you, either for the classmate's well-being or yours. If you feel this way, I would encourage you to report this behavior to the [NC State CARES website](#). Although you can report anonymously, it is preferred that you share your contact information so they can follow up with you personally.

Course Evaluations

ClassEval is the end-of-semester survey for students to evaluate the instruction of all university classes. The current survey is administered online and includes 12 closed-ended questions and 3 open-ended questions. Deans, department heads, and instructors may add a limited number of their own questions to these 15 common-core questions.

Each semester students' responses are compiled into a ClassEval report for every instructor and class. Instructors use the evaluations to improve instruction and include them in their promotion and tenure dossiers, while department heads use them in annual reviews. The reports are included in instructors' personnel files and are considered confidential.

Online class evaluations will be available for students to complete during the last two weeks of the semester for full-semester courses and the last week of shorter sessions. Students will receive an email directing them to a website to complete class evaluations. These become unavailable at 8 am on the first day of finals.

- Contact ClassEval Help Desk: classeval@ncsu.edu
- [ClassEval website](#)
- [More information about ClassEval](#)

Syllabus Modification Statement

Our syllabus represents a flexible agreement. It outlines the topics we will cover and the order in which we will cover them. Dates for assignments represent the earliest possible time they would be due. The

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pace of the class depends on student mastery and interests. Thus minor changes in the syllabus can occur if we need to slow down or speed up the pace of instruction.