

# PHYS:7729

# Plasma Physics II

# Spring 2021

**Instructor:** Gregory Howes  
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**Office Hours:** 10:45–12:15pm Th, 10:00am–11:30am F, or by appointment  
**Department:** Physics & Astronomy, 203 Van Allen Hall, Prof. Phil Kaaret, Chair

**Catalog Description:** Continuation of PHYS:4731: cold plasma waves, MHD stability, kinetic theory of plasmas, including Landau damping and velocity space instabilities; nonlinear evolution.

**Course Modality:** *Synchronous Online Course*  
Lectures will be held live on Zoom on the scheduled dates and times  
**Zoom Link:**  
<https://uiowa.zoom.us/j/92467721127?pwd=c0twMHQwWGFKTXpabUt5RWVCTHYvZz09>  
Meeting ID: 924 6772 1127  
Passcode: 7729

**Meeting:** Tuesday and Thursday, 9:30am - 10:45am  
Synchronous Zoom Teleconferences.

**Textbook:** Required: D. A. Gurnett & A. Bhattacharjee, *Introduction to Plasma Physics with Space and Laboratory Applications*  
Optional: T. J. M. Boyd & J. J. Sanderson, *The Physics of Plasmas*

**Web Page:** <http://www.physics.uiowa.edu/~ghowes/teach/phys7729/index.html>

**Exams** **Two Take-Home Midterm Exams:** Due on Friday, Mar 19 and Friday, Apr 23 at 5:00pm  
**Take-Home Final Exam:** Due on Wednesday, May 12, 5:00pm

**Grading:** Homework: 20%  
Two Midterm Exams: 20% each  
Final Exam: 40%

**Topics:**

1. MHD Waves	5. Kinetic Theory and Landau Damping
2. MHD Equilibria	6. Kinetic Stability
3. Multiple Timescale Method and Drifts	7. Quasilinear Theory
4. MHD Stability	8. Plasma Sheaths and Langmuir Probes

**Reference books:** R.D. Hazeltine and F.L. Waelbroeck, *The Framework of Plasma Physics*  
N.A. Krall and A.W. Trivelpiece, *Principles of Plasma Physics*  
D.R. Nicholson, *Introduction to Plasma Theory*

- Lecture Notes:** Lecture notes will be available *before* the synchronous Zoom lectures on my personal course website (not ICON) under “Lectures” at <http://homepage.physics.uiowa.edu/~ghowes/teach/phys7729/index.html>. You are encouraged to download and print out the notes for each lecture before the Zoom meeting so that you can follow along the lecture most easily and take notes as desired. The calendar below indicates when each lecture will be covered.
- Homework:** Homework will be assigned on a regular basis with a time allotment corresponding to the level of difficulty. The assignments will be available through my personal course website under “Homework” at <http://homepage.physics.uiowa.edu/~ghowes/teach/phys7729/index.html> or through the Assignments tab on ICON. Longer assignments will be weighted more heavily in the homework score. Late homework will not be accepted. Working through the homework problems is a critical step in learning the course material. You are encouraged to work together in groups on the homework, but each student must write his or her own solutions; you may discuss how to solve the problem together, but you may not copy another student’s solution. To turn in your homework, please scan your completed homework solutions into a *single* PDF file and submit the scanned PDF file on ICON by uploading the file to the appropriate assignment in the Homework group under the Assignments tab before the 5:00pm Friday deadline.
- Solutions:** Solutions for the homework assignments and midterm exams will be available only to enrolled students through the ICON course website under the “Files” section.
- Zoom Office Hours:** During the scheduled office hours, I will start a Zoom teleconference and be available. If other students are meeting with me, you may be asked to wait in the Zoom Waiting Room until I am free. To avoid confusion, the Zoom link for office hours is the same as the Zoom link for lectures:  
**Zoom Link:**  
<https://uiowa.zoom.us/j/92467721127?pwd=c0twMHQwWGFKTXpabUt5RWVCTHYvZz09>  
Meeting ID: 924 6772 1127  
Passcode: 7729
- Midterm Exams:** The two midterm exams will be given as take-home exams. The exams are all closed book and closed notes, but you may use a Formula Summary Sheet (see below). The midterm exams will be distributed by email through MAUI to each student immediately after the Tuesday Zoom lecture on the week of the exam, and will be due on Friday at 5:00pm. You should print out the exam so that you can write your solutions directly on the exam. You are allowed to use as much scratch paper (or additional sheets for writing the solutions) as you need, and you may use a calculator. You will have only 75 minutes to complete each exam, but you may take a 10 minute break (not counted as part of the 75 minutes) halfway through. During the break, you may not communicate with other students about the exam or consult the text, homework solutions, or lecture notes. To turn in your exam, please scan your completed exam (including any additional sheets you may have needed to write up the solutions) into a *single* PDF file and submit the scanned PDF file on ICON by uploading the file to the appropriate exam in the Exams group under the Assignments tab before the 5:00pm Friday deadline.

**Final Exam:** The final exam will be given as a take-home exam. The exam is closed book and closed notes, but you may use a Formula Summary Sheet (see below). The final exams will be distributed by email to each student immediately after the final Zoom lecture meeting on Thursday, May 6, 2021, and will be due at 5:00pm on Wednesday, May 12, 2021. You should print out the exam so that you can write your solutions directly on the exam. You are allowed as much scratch paper (or additional sheets for writing the solutions) as you need, and you may use a calculator. You will have only 120 minutes to complete the exam, but you may take a 10 minute break (not counted as part of the 120 minutes) halfway through. During the break, you may not communicate with other students about the exam or consult the text, homework solutions, or lecture notes. To turn in your exam, please scan your completed exam (including any additional sheets you may have needed to write up the solutions) into a *single* PDF file and email it to [gregory-howes@uiowa.edu](mailto:gregory-howes@uiowa.edu) before the 5:00pm Wednesday deadline.

**Formula Summary Sheets:** All exams are closed book and closed notes. For each exam, you are allowed to prepare a Formula Summary Sheet to use during the exam. You are also free to use the NRL Plasma Formulary. For each midterm exam, your Formula Summary Sheet may use two sides of 8.5 inch by 11 inch paper. You may also reference the Formula Summary Sheets from previous exams (which do not count against the two side limit). For the final, in addition to the four sides of Formula Summary Sheets from the two midterm exams, you may include one additional side of 8.5 inch by 11 inch paper (for a total of 5 sides of paper).

**Honor Code:** Course grading is only fair to all students if all students abide by the course honor code in completing homework assignments and take-home examinations. As detailed above, students are free to work together on the homework, but during exams communication with other students (by any means, including electronic communication) is strictly prohibited. You are expected to abide by the specified time limit for completing each exam, and you may not consult the text, homework solutions, or lecture notes during the exam (but you are allowed to use your Formula Summary Sheets and NRL Plasma Formulary, of course). The guidelines for each exam will be printed explicitly on the cover page, and the second page will be a statement that you must sign to indicate that you have abided by the Honor Code. You are not allowed to look at the exam before beginning the timed exam, so when printing out your exam please avoid the temptation to “sneak a peek.” Please do not discuss any of the exams with other students until *after* the deadline for that exam has passed.

**Posting Grades:** Homework and exam grades will be posted on ICON.

**COVID-19:**

- If you have symptoms consistent with COVID-19, stay home. Do not go to class or work while symptomatic. If you develop symptoms while on campus, go home or return to your dorm room. Call a health care professional who can assess your symptoms and risk factors and help you make a plan. **DO NOT** walk in to QuickCare, Student Health, any UI Health Care clinic, the State Hygienic Lab, or any emergency room. Consult your UI Health Care provider, Student Health, or personal health care provider to see if you need a COVID-19 test.
- You will not be penalized for missing this class due to illness, and I will work with you to ensure that you are able to make up work as needed.
- If you test positive for COVID-19, **you are strongly encouraged (though not required) to self-report via the university’s online system at this link, [Student Self-Report Form](#)**

This is critical so that contact tracing can be performed to prevent further spread of the virus.

- Self-isolate according to Centers for Disease Control and Prevention (CDC) guidelines:
  - 10 days since first symptoms
  - At least 24-hours with no fever (without fever reducing medication) and
  - Symptoms improved
- Inform close contacts and assist the Johnson County Health Department with contact tracing.

Week	Weekly Reading	Class Meeting	Date	Lecture Notes	HW/Exam/Review
1	Review GB Chap. 5, Sec. 5.4 (p.157–167) GB Chap. 6, Sec. 6.1–6.3 (p.186–202)	1	1/26	Lecture #1	
		2	1/28	Lecture #2	
2	GB Chap. 6, Sec. 6.4–6.6 (p.202–217)	3	2/2	Lecture #3	
		4	2/4	Lecture #4	HW#1 due 2/5, 5:00pm
3	GB Chap. 7, Sec. 7.1–7.2 (p.221–239) BS Chap. 4, Sec. 4.3–4.4 (p.82–107)	5	2/9	Lecture #5	
		6	2/11	Lecture #6	
4		7	2/16	Lecture #7	
		8	2/18	Lecture #8	HW#2 due 2/19, 5:00pm
5	GB Chap. 3, Sec. 3.6–3.7 (p.46–51)	9	2/23	Lecture #9	
		10	2/25	Lecture #10	
6	GB Chap. 7, Sec. 7.3–7.4 (p.239–263) BS Chap. 4, Sec. 4.5–4.7 (p.108–130)	11	3/2	BREAK: <i>No Lecture</i>	
		12	3/4	Lecture #11	HW#3 due 3/5, 5:00pm
7	GB Chap. 7, Sec. 7.5–7.6 (p.263–277)	13	3/9	Lecture #12	
		14	3/11	Lecture #13	
8	Review Lectures #1–13	15	3/16	Midterm #1 Review	
		16	3/18	No Lecture	Midterm #1, due 3/19, 5:00pm
9	GB Chap. 9, Sec. 9.1–9.3 (p.319–349) BS Chap. 7, Sec. 7.1–7.3 (p.252–268)	17	3/23	Lecture #14	
		18	3/25	Lecture #15	HW#4 due 3/26, 5:00pm
10	GB Chap. 8, Sec. 9.4–9.5 (p.349–370) BS Chap. 7, Sec. 7.4–7.5 (p.268–277)	19	3/30	Lecture #16	
		20	4/1	Lecture #17	HW#5 due 4/2, 5:00pm
11		21	4/6	Lecture #18	
		22	4/8	Lecture #19	HW#6 due 4/9, 5:00pm
12	GB Chap. 11.1 (p.428–441) BS Chap. 10, Sec. 10.1–10.2 (p.376–388)	23	4/13	Lecture #20	
		24	4/15	Lecture #21	HW#7 due 4/16, 5:00pm
13	Review Lectures #14–21	25	4/20	Midterm #2 Review	
		26	4/22	No Lecture	Midterm #1, due 4/23, 5:00pm
14	BS Chap. 11, Sec. 11.7 (p.453–458)	27	4/27	Lecture #22	
		28	4/29	Lecture #23	HW#8 due 4/30, 5:00pm
15		29	5/4	Lecture #24	
		30	5/6	Final Exam Review	
Finals Week, 5/10–5/14			5/12		Final Exam due 5/12, 5:00pm

**Textbooks:**

Required: **GB**=Gurnett & Bhattacharjee (2017) *Introduction to Plasma Physics: With Space and Laboratory Applications*

Optional: **BS**=Boyd & Sanderson (2003) *The Physics of Plasmas*

## College of Liberal Arts and Sciences

### Information for Undergraduates

Spring 2021

#### **Absences and Attendance**

Students are responsible for attending class and for contributing to the learning environment of a course. Students are also responsible for knowing course absence policies, which vary by instructor. All absence policies, however, must uphold the UI policy related to student illness, mandatory religious obligations, including Holy Day obligations, unavoidable circumstances, and University authorized activities (<https://clas.uiowa.edu/students/handbook/attendance-absences>). Students may use the CLAS absence form to aid communication with the instructor who will decide if the absence is excused or unexcused; the form is located on ICON within the top banner under "Student Tools."

#### **Academic Integrity**

All undergraduates enrolled in courses offered by CLAS have in essence agreed to the College's [Code of Academic Honesty](#). Academic misconduct affects a student's related grade and is reported to the College which applies an additional sanction including suspension. Outcomes about misconduct are communicated through UI email (<https://clas.uiowa.edu/students/handbook/academic-fraud-honor-code>).

#### **Accommodations for Disabilities**

UI is committed to an educational experience that is accessible to all students. A student may request academic accommodations for a disability (such as a mental health, attention, learning, vision, and a physical or health-related condition) by registering with Student Disability Services (SDS). The student is then responsible for discussing specific accommodations with the instructor. More information is at <https://sds.studentlife.uiowa.edu/>.

#### **Administrative Home of the Course**

The College of Liberal Arts and Sciences (CLAS) is the administrative home of this course and governs its add/drop deadlines, the second-grade-only option, and related policies. Other UI colleges may have different policies for courses offered by that college. CLAS policies may be found here: <https://clas.uiowa.edu/students/handbook>.

#### **Classroom Expectations**

Students are expected to comply with University policies regarding appropriate classroom behavior as outlined in the Code of Student Life (<https://dos.uiowa.edu/policies/code-of-student-life/>). This includes related UI policies and procedures that all students have agreed to regarding the COVID-19 pandemic. Particularly, each student must wear a face mask when in a UI building, including a classroom. The density of seats in classrooms has been reduced, and in some instances, this will allow 6 feet or more of distance while other cases, it may be less. Regardless, wearing a face mask and maintaining as much distance as is possible are vital to slowing the spread of COVID-19. In the event that a student disrupts the classroom environment through the failure to comply with a reasonable directive of an instructor or of the University, the instructor has the authority to ask that the student to leave the space immediately for the remainder of the class period. Additionally, the instructor is asked to report the incident to the UI Office of Student Accountability, with the possibility of additional follow-up with the student. Students who need temporary alternative learning arrangements (TALA) for a future semester related to COVID-19 should visit this website for more information: <https://coronavirus.uiowa.edu/temporary-alternative-learning-arrangements-tala>.

### **Class Recordings: Privacy and Sharing**

Some sessions of a course could be recorded or live-streamed. Such a recording or streaming will only be available to students registered for the course. These recordings are the intellectual property of the faculty, and they may not be shared or reproduced without the explicit written consent of the faculty member. Students may not share these sessions with those who are not enrolled in the course; likewise, students may not upload recordings to any other online environment. Doing so is a breach of the Code of Student Conduct and in some cases is a violation of the Federal Education Rights and Privacy Act (FERPA).

### **Communication and the Required Use of UI Email**

Students are responsible for official correspondences sent to the UI email address (uiowa.edu) and must use this address for all communication within or with UI ([Operations Manual, III.15.2](#)).

### **Complaints**

Students with a complaint about an academic issue should first visit with the instructor or course supervisor and then with the Chair of the department or program offering the course; students may next bring the issue to the College of Liberal Arts and Sciences. See this page for more information: <https://clas.uiowa.edu/students/handbook/student-rights-responsibilities>.

### **Final Examination Policies**

The final exam schedule is announced around the fifth week of classes; students are responsible for knowing the date, time, and place of a final exam. Students should not make travel plans until knowing this information. No exams of any kind are allowed the week before finals with a few exceptions made for particular types of courses such as labs or off-cycle courses: <https://registrar.uiowa.edu/final-examination-scheduling-policies>.

### **Nondiscrimination in the Classroom**

The University of Iowa is committed to making the classroom a respectful and inclusive space for people of all gender, sexual, racial, religious, and other identities. Toward this goal, students are invited in MyUI to optionally share the names and pronouns they would like their instructors and advisors to use to address them. The University of Iowa prohibits discrimination and harassment against individuals on the basis of race, class, gender, sexual orientation, national origin, and other identity categories set forth in the University's Human Rights policy. For more information, contact the Office of Equal Opportunity and Diversity (<https://diversity.uiowa.edu/eod>; or [diversity.uiowa.edu](https://diversity.uiowa.edu))

### **Sexual Harassment**

Sexual harassment subverts the mission of the University and threatens the well-being of students, faculty, and staff. All members of the UI community must uphold the UI mission and contribute to a safe environment that enhances learning. Incidents of sexual harassment must be reported immediately. For assistance, please see <https://osmrc.uiowa.edu/>.