

Plasma and Fusion

ENU 4930/6937

Class Periods:

Mondays, Periods 7 (1:55 pm – 2:45 pm), Online
Wednesdays, Period 7 (1:55 pm – 2:45 pm), Online
Fridays, Period 7 (1:55 pm – 2:45 pm), Online

Location: Online

Academic Term: Spring 2021

Instructor;

Chris McDevitt, Associate Professor

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352-846-3785

Office Hours: Tuesdays, 9:30 pm – 10:30 pm, or by appointment

Course Description

3 credit hours.

This course provides an introduction to plasma physics along with its application to fusion science.

Course Pre-Requisites / Co-Requisites

Introductory physics courses, or by instructor permission.

Course Objectives

1. Provide students with an understanding of the fundamentals of fusion energy science.
2. Give a broad introductory account of the basic principles of plasma physics
3. Demonstrate how fundamental concepts in plasma science are used to constrain the design concepts of fusion reactors

Required Textbook

- Introduction to Plasma Physics and Controlled Fusion
- Francis F. Chen
- 3rd Edition
- ISBN 978-3-319-22308-7

Recommended Textbook

- Plasma Physics and Fusion Energy
- Jeffrey Freidberg
- ISBN 978-0-521-73317-5

Recommended Materials

- NRL Plasma Formulary
- U.S. Naval Research Laboratory
- A hard copy can be obtained at no charge from: <https://www.nrl.navy.mil/ppd/content/nrl-plasma-formulary>

Course Schedule

Week 1: Light element fusion reactions and fundamentals of fusion power

Week 2: Cross sections, mean-free-path and the fusion reactivity integral Quiz 1

Week 3: Coulomb collisions and Bremsstrahlung radiation HW 1

Week 4: Power balance and ignition criteria Quiz 2

Week 5: Approaches to fusion energy	HW 2	Exam 1
Week 6: Debye Shielding and plasma fundamentals	Quiz 3	
Week 7: Charged particle motion (1)	HW 3	
Week 8: Charged particle motion (2)	Quiz 4	
Week 9: Plasmas as fluids (1)	HW 4	
Week 10: Plasmas as fluids (2)	Quiz 5	
Week 11: Magnetohydrodynamic equilibrium		Exam 2
Week 12: Waves in plasmas (1)	HW 5	
Week 13: Waves in plasmas (2)	Quiz 6	
Week 14: Fluid instabilities (1)	HW 6	
Week 15: Fluid instabilities (2)	Quiz 7	

Online Course Recording

Our class sessions may be audio visually recorded for students in the class to refer back and for enrolled students who are unable to attend live. Students who participate with their camera engaged or utilize a profile image are agreeing to have their video or image recorded. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who un-mute during class and participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and communicate exclusively using the "chat" feature, which allows students to type questions and comments live. The chat will not be recorded or shared. As in all courses, unauthorized recording and unauthorized sharing of recorded materials is prohibited.

Attendance Policy, Class Expectations, and Make-Up Policy

Class attendance is encouraged but not required. Quizzes will, however, be administered during class. Excused absences must be consistent with university policies in the undergraduate catalog (<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>) or graduate catalog (<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#attendance>) and require appropriate documentation. No make-up quizzes will be given, however, the lowest two scores will be dropped.

Evaluation of Grades

Assignment	Percentage of Final Grade
Homework Sets	30%
Quizzes	20%
Exam 1	15%
Exam 2	15%
Final Exam	20%
	100%

Homework assignments will be posted on Canvas. The lowest homework score will be dropped. Students may work in groups. Quizzes will be given approximately bi-weekly throughout the semester, and administered in class. These quizzes will generally focus on the material covered during the previous two weeks' lecture material. Two midterm exams will be given along with a final exam.

Grading Policy

Grade	Grade Points
A	4.00
A-	3.67
B+	3.33
B	3.00
B-	2.67
C+	2.33

C	2.00
C-	1.67
D+	1.33
D	1.00
D-	0.67
E	0.00

More information on UF grading policy may be found at:

<https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#grades>

Students Requiring Accommodations

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, <https://www.dso.ufl.edu/drc>) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

Course Evaluation

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.aa.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>.

University Honesty Policy

UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor Code (<https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Commitment to a Safe and Inclusive Learning Environment

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Program Coordinator
- Robin Bielling, Director of Human Resources, 352-392-0903, rbielling@eng.ufl.edu
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

Software Use

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as

appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Student Privacy

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <https://registrar.ufl.edu/ferpa.html>

Campus Resources:

Health and Wellness

U Matter, We Care:

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

Counseling and Wellness Center: <http://www.counseling.ufl.edu/cwc>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Discrimination, Harassment, Assault, or Violence

If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the **Office of Title IX Compliance**, located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, title-ix@ufl.edu

Sexual Assault Recovery Services (SARS)

Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

Academic Resources

E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu.
<https://lss.at.ufl.edu/help.shtml>.

Career Resource Center, Reitz Union, 392-1601. Career assistance and counseling. <https://www.crc.ufl.edu/>.

Library Support, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring.
<https://teachingcenter.ufl.edu/>.

Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers.
<https://writing.ufl.edu/writing-studio/>.

Student Complaints Campus: https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf.

On-Line Students Complaints: <http://www.distance.ufl.edu/student-complaint-process>.