PHY 390: Special Topics in Physics, Introduction to Plasma Physics, Spring 2020

Date of this version of the Syllabus: 3/27/2020

Course Description:

The course starts with a definition of plasma as well as a discussion of its important properties including temperature and useful temporal and spatial scales. This will be followed by a detailed study of the motion of a single charged particle in electric and magnetic fields. Collective effects such as diffusion, resistivity, and waves in plasma will be discussed in the context of the fluid and kinetic models.

Prerequisite: PHY 301

3 credits

Class Meeting Times: Tuesday/Thursday 1:00-2:20 PM. Course lectures will be delivered at class time through Zoom software. The proper link for the meetings will be shared on a Blackboard Announcement and calendar invites will be sent to everyone's Stony Brook e-mail accounts. Each lecture is recorded with links shared on Blackboard.

Course Instructor: Navid Vafaei-Najafabadi,
e-mail (For private communication, Reply in 24-48 hours): navid.vafaei-najafabadi@stonybrook.edu
Office: Physics D101
Office hours (preferred method of contact): Wednesday 3-5 pm, Friday 10:30 am -12 pm. Zoom link and calendar invites will be for accessing during office hours will be sent to students

If you cannot reach your instructor, please email CAS_Dean@stonybrook.edu.

Grader: Kedarsh Kaushik
e-mail: kedarsh.kaushik@stonybrook.edu

Required Text:

Introduction to Plasma Physics and Controlled Fusion, Volume 1: Plasma Physics, F. F. Chen
This book is the primary text for the course. We generally follow the same flow as the book

Topics & Approximate Timeline:

The focus of the class will be on covering the most important aspects of plasma physics. The topics and the approximate time devoted to each during the semester will be as follows:
1. Introduction to plasma, important parameters and scales (1.5 week)
2. Single-particle motions (2 weeks)
3. Fluid theory and waves in plasmas (4 weeks)
4. Magnetohydrodynamics in plasmas (1 week)
5. Kinetic theory of waves in plasmas (3.5 weeks)

Learning Outcomes and Objectives:

Upon completing this course, students will be able to

- Calculate the important properties and scales in plasma
- Analyze the motion of a charged particle in a static/time varying electric field and static/time varying magnetic field
- Classify plasma waves and predict the behavior of each type of wave
- Describe the magnetohydrogynamic assumptions and behavior of plasma under such assumptions
- Apply kinetic theory of plasma to describe plasma wave phenomena such as Landau damping

Grade Breakdown:

Homework: 15%

Homework will contain problem sets that will be posted on Thursday to the folder "Assignments" on Blackboard and will be due by the end of the day on the next Thursday. Students can upload their assignments to Blackboard (preferred method) or send via e-mail to the grader and cc the instructor.

Midterm 1: 25%

The first midterm will be take home. It will be due on March 31st, either submitted on Blackboard or by e-mail to instructor

Midterm 2: 30 %

The second midterm will be **on Tuesday, April 21st**, during class time. The exam will be open book. Access will be given to the file posted on "Exams" section of the Blackboard for 90 minutes starting from 1 pm. The exam will be 75 minutes and students will be expected to use the other 15 minutes to upload their answers by 2:30 pm to the Blackboard website (preferred method) or send to instructor via e-mail.
This midterm covers only the topics discussed after Mar. 5th exam (i.e. not cumulative)

Final: 30 %

Currently scheduled on **Tuesday, May 19th at 2:15- 5pm**. The exam will be open book. Access will be given to the file posted on the "Exams" section of the Blackboard starting at 2:15 pm. Students will be given a minimum of 15 minutes to upload their answers to the Blackboard website (preferred method) or send them to the instructor via e-mail.

Final exam will be cumulative, and will include all topics covered in class

Please use a scanning app on your phone to take legible pictures of the exam papers before uploading them.

You are responsible for ensuring that you can attend all exams at the scheduled days and times. An important part of your responsibility at the beginning of the semester is to make sure your schedule will allow for an orderly adherence to the class and exam calendars. If you miss an exam without a valid excuse that must be **documented in writing**, you will NOT be allowed to make up that missed exam. Your grade on it will be zero.

Notes on Homework

Every Thursday five to ten homework problems from each chapter will be posted on Blackboard. The usual deadline would be the following Thursday. Homework represents the primary avenue of practice for the course material. Don't wait until the last minute to work on them!

Rules Regarding Homework:

- You may collaborate with your classmates on the homework if you are contributing to the solution. You must personally write up the solution of all problems.
- Do not forget that simply copying somebody's solutions does not help you in a long run (especially on the exam).
- You may (and are encouraged to) use the library and all available resources to help solve the problems. Use of Mathematica, other software tools and spreadsheets are encouraged.
- Late homework: Homework is accepted until the end of the following Tuesday class, but will incur a 20% penalty/(business) day late.

Academic Resources:

If you find that you are struggling with the course material throughout the semester, consider taking advantage of resources provided by the university:

Student Success Resources:

A helpful resource is the *"For Students"* section linked from the Stony Brook homepage: http://www.stonybrook.edu/for-students as well as the Division of Undergraduate Education website: http://www.stonybrook.edu/commcms/due/index.html.

Academic Success and Tutoring Center:

This important program opened in September 2013. Information can be found at: http://www.stonybrook.edu/commcms/academic_success/.

Posting and Updating of This Syllabus

This Syllabus will be posted on Blackboard. When, from time to time, it may be updated, all students will be notified by an Announcement posted in Blackboard and sent via email to your official University

email address. Please make sure you're looking at the most recent version: Check the first page of each one to see the date of the version you're looking at!

University Policies

Student Accessibility Support Center (SASC) Statement:

If you have a physical, psychological, medical or learning disability that may impact your course work, please contact the Student Accessibility Support Center (SASC), ECC (Educational Communications Center) Building, room 128, (631) 632-6748. They will determine with you what accommodations, if any, are necessary and appropriate. All information and documentation is confidential.

Students who require assistance during emergency evacuation are encouraged to discuss their needs with their professors and the staff at the Student Accessibility Support Center (SASC). For procedures and information go to the following website: http://www.stonybrook.edu/ehs/fire/disabilities

Academic Integrity Statement:

Each student must pursue his or her academic goals honestly and be personally accountable for all submitted work. Representing another person's work as your own is always wrong. Faculty are required to report any suspected instances of academic dishonesty to the Academic Judiciary. Faculty in the Health Sciences Center (School of Health Technology & Management, Nursing, Social Welfare, Dental Medicine) and School of Medicine are required to follow their school-specific procedures. For more comprehensive information on academic integrity, including categories of academic dishonesty, please refer to the academic judiciary website at http://www.stonybrook.edu/commcms/academic_integrity/index.html

Critical Incident Management Statement:

Stony Brook University expects students to respect the rights, privileges, and property of other people. Faculty are required to report to the Office of Judicial Affairs any disruptive behavior that interrupts their ability to teach, compromises the safety of the learning environment, or inhibits students' ability to learn. Faculty in the HSC Schools and the School of Medicine are required to follow their school-specific procedures.

Regarding Equivalent Opportunity/Religious Absences:

https://www.stonybrook.edu/sb/bulletin/current/policiesandregulations/policies_expectations/equivopportunity_religiousabsences.php

Student Participation in University-Sponsored Activities:

By their participation in campus-related activities such as research conferences, dramatic or musical performances, intercollegiate athletic competitions, or leadership meetings, students make contributions to the University. In recognition of the students' commitment both to their regular academic programs and to related activities, the University makes every effort to accommodate unique situations.

Students are responsible for presenting a printed copy of semester obligations to all their professors at the beginning of the semester to alert them to activities that may present conflicts. Instructors are required to make arrangements for students to complete examinations, quizzes, or class assignments early or late if the student's participation in a University-related activity results in the student's absence from the class when such work is due. Some events occur only by invitation during the semester, and instructors should make accommodations for these students.

Minimal instructional and student responsibilities:

www.stonybrook.edu/sb/bulletin/current/policiesandregulations/policies_expectations/