Syllabus
PTYS 505A – Fall 2018
Principles of Planetary Physics

Course Description: Introductory physics of planetary and interplanetary gases, fluids and plasmas. Thermodynamics, kinetic theory, plasma physics, hydrodynamics, and magnetohydrodynamics with solar-system applications. This includes planetary atmospheres, solar wind, solar-system magnetic fields, dynamo theory, planetary magnetospheres, the heliosphere, and cosmic rays.

Meeting Time: M, W 9:30-10:45AM – Kuiper Space Sciences Room 312

Instructor: Joe Giacalone (Professor, Department of Planetary Sciences)
Office: Kuiper Space Sciences – Room 411
Tel: 626-8365; Email: giacalon@lpl.arizona.edu
Office Hours: after class (or just stop by, but please send an email before coming over)
Administrative Assistant: Vicki Robles de Serino (Room 415; tel: 621-9692)

Prerequisites: Students should be familiar with classical physics, thermodynamics, electricity and magnetism, vector calculus and both ordinary and partial differential equations.

Grading: Your final grade will be based on a cumulative performance on homework and exams. Final grades may be based on a common statistical curve, but you are assured of the following grade based on your overall final average: (A) 90% or above, (B) 80-90%, (C) 70-80%, (D) 60-70%. The weighting of the assignments is as follows:

50% Problem sets (~5-6 assignments)
20% Mid-term exam
30% Final exam

Assignments and Exams: There will be ~4-5 homework assignments. They will be announced in class and will be available for download from the course website. The assignment must be turned in on the due date at the beginning of class, generally one week after it is assigned. Solutions to the homework assignments will be made available on the website. Late homework will not be accepted once solutions are posted on the course website.

The mid-term and final exams will (tentatively) be take-home format. Details will be discussed in class.

Course Website:
http://www.lpl.arizona.edu/~giacalon/505A-fall18/
The website will post class lectures (scanned transparencies in pdf format, some PowerPoint slides and movies), and solutions to homework.

Textbook: There is no required textbook for this course. However, the following two text books are particularly relevant to topics to be discussed in this class and are among my favorites for plasma physics applied to the solar system and astrophysical plasmas. The first one should be at about the right level for students in this class, the second one is a bit more for students interested in delving a bit deeper into plasma physics.

1. "Physics of Solar System Plasmas" Thomas E. Cravens, Cambridge University Press (Atmospheric and Space Science Series)
2. "The Physics of Plasmas" T.J.M. Boyd and J. J. Sanderson, Cambridge University Press

In addition to these, the internet is (usually) a good source of information for classical subjects such as thermodynamics, covered in the beginning of the semester, kinetic theory, distribution function, etc. If you find a good discussion on the internet, but have questions, bring them to class and lets talk about them.

General Policies:

Academic Integrity: For general guidelines on this, please refer to the University's code of academic integrity: http://deanofstudents.arizona.edu/codeofacademicintegrity

With regards to homework for this class: you are strongly encouraged to work with other students; however, the work that you turn in must be your own.

Attendance: This course will adhere to the University's policies, as found in the linksbelow

The UA's policy concerning Class Attendance, Participation, and Administrative Drops is available at: http://catalog.arizona.edu/policy/class-attendance-participation-and-administrative-drop

The UA policy regarding absences for any sincerely held religious belief, observance or practice will be accommodated where reasonable, http://policy.arizona.edu/human-resources/religious-accommodation-policy.

Absences pre-approved by the UA Dean of Students (or Dean Designee) will be honored. See: https://deanofstudents.arizona.edu/absences

Note, although lectures and assignments will be posted on the course website, success in this course will require that you attend and participate in each class

Threatening Behavior Policy: This course will adhere to The UA Threatening Behavior by Students Policy, which prohibits threats of physical harm to any member of the University community, including to oneself. See http://policy.arizona.edu/education-and-student-affairs/threatening-behavior-students.

Accessibility and Accommodations: It is the University's goal that learning experiences be as accessible as possible. If you anticipate or experience physical or academic barriers based on disability or pregnancy, please let me know immediately so that we can discuss options. You are also welcome to contact Disability Resources (520-621-3268) to establish reasonable accommodations. Please be aware that the accessible table and chairs in this room should remain available for students who find that standard classroom seating is not usable.

Non-discrimination and anti-harassment policy: This course will adhere to the UA Nondiscrimination and Anti-harassment Policy. The University is committed to creating and maintaining an environment free of discrimination; see http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy

Note that the workload and course requirements are subject to change at the discretion of the instructor with proper notice to the students.

TENTATIVE SCHEDULE OF LECTURE TOPICS

Aug 20 Course orientation. Introduction.	Aug 22 Review of Classical thermodynamics 1.
Aug 27 Review of Classical thermodynamics 2	Aug 29 Review of Classical thermodynamics 3
Sep 3 NO CLASS (LABOR DAY)	Sep 5 Kinetic Theory of Gases, Macroscopic equations
Sep 10 Application to plane-parallel, adiabatic, and spherical atmospheres (hydrostatic equilibrium)	Sep 12 Distribution function
Sep 17 The Boltzmann and Vlasov equations, Lioville's theorem (GUEST LECTURE)	Sep 19 NO CLASS (INSTRUCTOR AWAY)
Sep 24 Maxwell-Boltzmann distribution, Jean's escape in a planetary atmosphere	Sep 26 A non-static atmosphere: Parker's solar wind solution
Oct 1 Hydrodynamic equations, Bernoulli's theorem	Oct 3 Application: water waves, gravity waves
Oct 8 Application: flow of a fluid past a sphere	Oct 10 Other applications, catchup day
Oct 15 Shock waves	Oct 17 Blast waves
Oct 22 Intro to Plasmas, Debye sphere	Oct 24 Magneto-hydrodynamic (MHD) equations
Oct 29 Application: The Solar Magnetic Field	Oct 31 Solar magnetic field 2, Dynamo, Sunspots
Nov 5 The interplanetary magnetic field: the "Parker Spiral"	Nov 7 The Heliosphere
Nov 12 NO CLASS (VETERAN'S DAY)	Nov 14 Planetary Magnetospheres
Nov 19 Charged Particle motion in electric and magnetic fields 1	Nov 21 Charged Particle motion in electric and magnetic fields 2: adiabatic theory, application to trapped radiation in magnetosphere
Nov 26 Plasma oscillations and waves	Nov 28 Plasma turbulence
Dec 3 Cosmic ray transport	Dec 5 Other applications, catch up day