The Solar System and Extrasolar Planets

Astronomy 1122, University of Pittsburgh *(Spring 2025)*

Syllabus – Version 3 – 2025-01-17

Course Information

Meeting Time: Tue, Thu 11:00am-12:15pm. 3 credits. Meeting Location: Allen 103

Instructor Information

- Lecturer: Prof. Michael Wood-Vasey, wmwv@pitt.edu
  Office Hours: Thu 2:30-4:30pm
  My office is Allen 320.

Course Description

We will learn about our Solar System and planetary systems around other stars. We will cover the things we know about our Solar System, how we know them, what big questions remain. We will discuss planets and planet formation around other stars, observational techniques, theoretical models, and the possibilities for life. We will end by talking about current and future missions to learn more about our Solar System and planetary systems around other stars.

Course Structure

Lectures (TuTh) will be interspersed with short exercises and synchronous group work. Homework will be due weekly on Fridays. There will be 2 mid-term exams, a semester project, and a cumulative final.

- Before each lecture class (*including the first class*) you will be expected to complete:
  (1) Reading; (2) Video; (3) Reading Quiz

Logistics

Classes will be in person. If during the term you find yourself not able to attend in person for some number of days, please let me know and I will work together with you to come up with an effective plan to supplement your experience.

Grading

Percentage	Component
5%	Reading Quizzes
20%	Homework
10%	Homework Quizzes
15%	Midterm 1
15%	Midterm 2
10%	Project
25%	Final

Textbook, Videos, and References

1. REQUIRED: "Fundamental Planetary Science: Physics, Chemistry and Habitability" Revised Edition (2019) (says "Updated Edition" on the cover) Jack Lissauer and Imke de Pater Cambridge University Press ISBN-13: 978-1108411981
2. I will provide videos to watch before most of lectures. These will be a combination of videos recorded by me and additional videos from different excellent sources on the web.
3. I may provide some additional supplemental readings during the semester. Read them.
4. We are fortunate to live in a rich, interconnected time in human history. There is a wealth of information available online about each of the topics we will cover. I encourage you to pursue additional materials, particularly on issues that you are having trouble understanding initially.

Reading assignments follow the schedule outlined in the Planned Calendar below.

Planned Calendar

Week of	Reading	Planned material	Calendar Notes
01/06	Chp. 1	Our Solar System	*Classes start: Wed, Jan 8*
01/13	Chp. 1,2	Orbital Dynamics	
01/20	Chp. 2	Orbital Dynamics	
01/27	Chp. 3	Physics and Astrophysics	
02/03	Chp. 4	Solar Heating and Energy Transport	
02/10	Chp. 1–4	Review	*Exam 1, Feb 13, Thu*
02/17	Chp. 12	Minor Planets and Comets	
02/24	Chp. 14	Detecting Extrasolar Planets	
03/03	—	—	*Spring Break*
03/10	Chp. 14	Detecting Extrasolar Planets	
03/17	Chp. 15	Planet Formation	
03/24	Chp. 12–15	Review	*Exam 2, Mar 25, Tue*
03/31	—	Short Lectures on Project Topics	
04/07	—	Working on Projects	
04/14	—	In-Class Presentations	
04/21	All	Review	Class Tue 4/22
04/28	All	Final	*Final*, Apr 29, Tue 10:00-11:50am

Participation: Reading, Videos, and Reading Quizzes

In this course you will be responsible for both your own and your colleagues's learning. Being prepared for class is a key part of aiding both your learning and that of the class.

To help you focus on being prepared for the material ahead of time, there will be Reading Quizzes due at 10:00am, one hour before each class day. The one hour is for me to read through and see what everyone understands well and where we should spend some more time. These are open-book, open-note; in fact, going back to the book to check on something again is sort of the

point of many of the questions. Late reading quizzess completed before the class meeting after the originally due class day will receive half credit; after that date they will receive no credit.

Read the book! Watch the videos! Take the reading quiz! One way in which you can assist your colleague's learning is to ask questions. If you are confused about something, you are almost definitely not alone; others will also be confused. Another key way is to fully participate in in-class interactive discussions and small-group discussions. You will be formally assessed on the reading quizzes, because that is the easiest thing to measure and record, but it represents the larger participation effort.

Homework

Each week you will complete a homework assignment that uses the material for the current week and builds on previous material. Assignments will be posted on Canvas. Completed homework, with your name, "Astronomy 1122", and "Prof. Wood-Vasey" clearly on the assignment, should be submitted through the "Homework" slot under the Physics Department mailboxes on the 1st floor of Allen Hall.

Homeworks will be graded on completeness, with one or two problems each week graded for correctness. Homework will be due Fridays at 4:00pm. Late homework will be accepted at 25% off for one class day late (i.e., the following Tuesday). Homework will not be accepted past that Tuesday because I will have posted the homework solutions that day in preparation for the in-class quiz.

Working and discussion with classmates is very much encouraged, but solutions should be your own. Please list the names of your colleagues with whom you worked on each homework assignments. There is no particular credit assigned to such a list – this is for your own benefit to acknowledge credit and contributions.

Homework is an opportunity to develop your understanding of the course material. Be honest with yourself about whether or not you fully understand a problem. The quizzes and exams will test this.

Homework Quizzes

There will be in-class quizzes approximately once/week. These will closed-note, closed-book quizzes on the homework from the previous week plus some simple questions on the for the current week. To prepare for the quizzes, (1) make sure you understand and can do all of the parts of the homework on your own; (2) do the reading for the current week.

Midterm Exams

There will be two mid-term exams during the semester.

The exams will be closed-book. You will be allowed to bring in notes on both sides of one regular-sized piece of paper. You will write your answers in the "blue books" that will be distributed along with the questions for the exam. You will be allowed calculators so that we can ask interesting real-life-inspired problems.

Many questions will ask you to use sentences, diagrams, and equations to answer problems. You will lose points if you do not include all three methods to explain your answer.

Revision: You may turn in a new set of solutions for an exam for up to half credit on the points you missed. The new solutions must also include an explanation of what you were thinking in

your original attempt and how you would explain to your past self what a correct approach and solution to the problem would be. These new solutions will be due a week after I return the graded exams to the class.

Project

There will be a semester project that will incorporate your learning, your literature, analysis, and programming to advance your, your classmates, and my knowledge about planets around our star and others. I'm still working on the details.

Final Exam

There will be a cumulative final at the end. As for the mid term exams, you will be allowed notes on both sides of one regular-sized piece of paper.

There will be no revision opportunity for the final.

Acknowledgments

Attribution and credit is the core currency of respect and recognition in science.

The structure, lectures, assignments and other material in this course are based on an extensive history of physics education over the past 100 years, with roots extending beyond that. More specifically, I've benefitted in my preparation from previous editions of this course taught by Prof. Carles Badenes and Prof. Melanie Good.

Similarly, please credit your colleagues with whom you discuss and work with on homework and other projects.

Disabilities

If you have a disability for which you are or may be requesting an accommodation, you are encouraged to contact both your instructor and the Office of Disability Resources and Services, drsrecep@pitt.edu, 140 William Pitt Union, 412-648-7890, or (412) 228-5347 for P3 ASL, as early as possible in the term. Disability Resources and Services will verify your disability and determine reasonable accommodations for this course.

Email and Canvas Communication Policy

Each student is issued a University email address (username@pitt.edu) upon admittance. This email address may be used by the University for official communication with students. Students are expected to read email sent to this account on a regular basis. Failure to read and react to University communications in a timely manner does not absolve the student from knowing and complying with the content of the communications. The University provides an email forwarding service that allows students to read their email via other service providers (e.g., AOL, GMail, Hotmail, Proton, Yahoo). Students that choose to forward their email from their pitt.edu address to another address do so at their own risk. If email is lost as a result of forwarding, it does not absolve the student from responding to official communications sent to their University email address. To forward email sent to your University account, go to https://accounts.pitt.edu, log into your account, click on Edit Forwarding Addresses, and follow the instructions on the page. Be sure to log out of your account when you have finished. (For the full email Communication Policy, go to https://www.bc.pitt.edu/policies/policy/09/09-10-01.html.)

You are responsible for following announcements on Canvas. By default these are sent to your Pitt email account. If you choose to change these notification settings, you remain responsible for understanding the content in Canvas notifications in a timely manner.

Academic Integrity

Cheating/plagiarism will not be tolerated. Students suspected of violating the University of Pittsburgh Policy on Academic Integrity, noted below, will be required to participate in the outlined procedural process as initiated by the instructor. A minimum sanction of a zero score for the quiz, exam or paper will be imposed. For the full Academic Integrity policy, please see https://www.provost.pitt.edu/info/ai1.html

Code of Conduct

Communication is key to a productive learning environment, and we can maintain productive communication by exhibiting respect for one another. The success of the course for yourself and others depends on all of our commitment to behavior that demonstrates respect for differences, understanding towards others and a willingness to listen and learn.

The University of Pittsburgh does not tolerate any form of discrimination, harassment, or retaliation based on disability, race, color, religion, national origin, ancestry, genetic information, marital status, familial status, sex, age, sexual orientation, veteran status or gender identity or other factors as stated in the University's Title IX policy. The University is committed to taking prompt action to end a hostile environment that interferes with the University's mission. For more information about policies, procedures, and practices, see: https://diversity.pitt.edu/affirmative-action/policies-procedures-and-practices.

Use of Class Recordings

Course meetings may be recorded by the instructor for the benefit of students who are not able to participate synchronously. Any such recordings are not to be used or distributed outside the context of this course.

Learning Objectives

Learning objectives are the list of things that you should be able to demonstrate that you can do by the end of this course. You might thus choose to call this section the "Study Outline". After completion of course students will be able to:

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1) Understand the nature of sub-stellar objects, specifically in stellar systems
2) Be able to explain how stars & star systems form
3) Understand and explain questions in current exoplanet research
4) Major objects & classes in our Solar System
 * Oort Cloud
 * Kuiper Belt Objects
 * Asteroids & Comets
 * Dust
 * Planets
   -- Composition
   -- Distribution
   -- Formation
   -- Heat Transfer
   -- Hydrostatic Equilibrium
   -- Phases
5) Major questions in Solar System research
6) What have we learned from Solar System probes?
7) What is coming up in the next 10 years
8) What is hard about Solar System research:
 * Physics, tecyhnology, money, timescales, socio-geo-politics
8) What is hard about Exoplanet research:
10) Major techniques in Solar System research
11) Major techniques in Exoplanet research

Skills
1) Analyze & Numerically calculate orbits, R_V, transit
2) Analyze real data - transmissions, spectrum, lightcurves
3) Can interpret & critique press releseases and articles in the popular press
4) Can develop planetary & exoplanetary exploration missions
5) Can use diagrams & prose to explain key concepts

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Prereq
* Read and plot data from standard simple data files.
* Integrate a density profile to obtain a total.
* Take derivates of potential functions commonly found in physics.
* Ability to understand a 2-D differential equation.
* Relate pressure to force and equilibrium
* Compute the energy emission of a black body given its temperature and pressure.
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