Astronomy 1122: Solar System and Exoplanets
Spring 2021
Synchronous Zoom sessions: Tuesdays and Thursdays 11:05AM-12:20PM
Instructor Office Hours: Mondays 12:00-1:00PM, Thursdays 4:00PM-5:00PM

Contact Information:

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Prerequisites: ASTRON 0113 or 0413, and PHYS 0111 or 0175, or 0476

Course Description: A study of planets and other sub-stellar objects, both in our Solar System and in other planetary systems, taught at an advanced undergraduate level. Topics include planet formation, planet structure, the relationship between planets and their host stars, and a scientific discussion about the possibility of life in other planets.

Textbook (required): *Fundamental Planetary Sciences* by Lissauer and de Pater ISBN: 9781108359245, ($52 for e-book, or $64.99 for paperback on Cambridge University Press, or similar on Amazon and other retailers. This book contains the majority of the material we will study. It goes more in depth on some geology and planetary science topics than we will need, so for those topics, a few chapters from the recommended textbook below, will serve as the main reference, as they are more concise. In addition, I will aim to supplement this book's coverage of exoplanets, partly from the optional book below, and partly from other non-textbook sources.)

Additional Textbook (recommended): *An Introduction to Modern Astrophysics* 2nd Edition by Caroll and Ostlie ISBN: 978-0805304022 ($82 for e-book or ∼$100 for hard copy on Cambridge University Press, but can be rented on Amazon for $33.97, or obtained used at a discount from Amazon and other retailers. This is a great reference text that is extremely comprehensive, covering basically any astrophysics topic you can think of, from planets to stars to galaxies, etc–it may be useful for Astron1120 and Astron1121, in addition to this class. It's getting a little dated, at this point, on some of the most recent discoveries and advances in astronomy, such as gravitational waves and exoplanets, but it thoroughly covers the underlying physics involved in a wide variety of astronomical phenomena at an upper-level undergraduate to introductory graduate level.)

Additional Textbook (optional): *The Exoplanet Handbook* 2nd Edition by Perryman ISBN: 9781108419772 ($68.00 for e-book or $84.99 on Cambridge University Press or can be rented for $42.50 on Amazon, or used at a discount from Amazon and other retailers. This book is a comprehensive summary of basically all the important scientific literature on exoplanets to date. Very detailed and technical. Useful for someone interested in exoplanet research. May be better to rent, since the field is so quickly changing, and new discoveries are occurring constantly, so this will likely be out of date in 5-10 years)

Course Objectives:

At the end of the course, students should be able to explain, among other things:

- The basic properties of the planets in our Solar System.
- The most common methods to detect exoplanets, and their strengths and weaknesses, as well as the use of multiple techniques that complement each other.
- The basic physical properties of the exoplanets that have been detected to date, and how they relate to the properties of their host stars.
- How planet formation is thought to take place, and the evidence for different formation and evolutionary mechanisms, as well as how well current models agree with the observational data and what they predict about the properties of planetary systems.
- What features give a planet a high potential for sustaining life, in particular the properties of its host star, its orbit, and its atmosphere.

Honor Code:

Students are expected to uphold the University's standard of conduct relating to academic honesty. Students assume full responsibility for the content and integrity of the academic work they submit. Students shall be guilty of violating the honor code if they:

1. represent the work of others as their own
2. use or obtain unauthorized assistance in any academic work
3. give unauthorized assistance to other students
4. modify, without instructor approval, an examination, paper, record, or report for the purpose of obtaining additional credit
5. misrepresent the content of submitted work

Any student violating the honor code is subject to receive a failing grade for the course and will be reported to the Vice President of Academic Affairs.

Additional Academic Integrity Information for Online Classes:

Online classes may appear to allow freer access to information from sources offering "tutoring" services or other help to students, but please be aware that the University Honor Code is expected to be upheld to the same degree for online classes as for in-person classes. Students who utilize online tutoring services, solutions manuals, videos, or other online resources to represent their own work are in violation of the above Honor Code, and will be subject to the same consequences as any academic integrity violation which would occur during an in-person class. Academic honesty is taken very seriously by the University and every effort will be made to ensure that all students enrolled in online courses are upholding the expectations of the University Honor Code.

Grading Scheme:

- 10 % for Participation
- 30 % for Homework
- 20 % for Midterm
- 20 % for Final Project
- 20 % for Final Exam

See below for description of each grading component.

Particpation (worth 10% of grade): To reflect that different students may have different scheduling constraints, participation will be somewhat flexible. Students must participate 10 times, and can choose how to participate among the following available activities, in any combination students choose: 1. During synchronous lecture sessions, ask a question or contribute to class discussion. You are encouraged to do this verbally, but may use the chat function if preferred. If you do not want to direct your question to the entire class, it can be directed to the instructor privately in the chat options. 2. Contribute a genuine response or question in the discussion board posts created by your instructor on Canvas. These posts will be created approximately once per week.

Homework (worth 30% of grade): Homework assignments will be integrated into Canvas, and will consist mostly of open-ended problems, for which you will need to either upload a pdf or image files of your solutions. You are encouraged to discuss homework problems with fellow students. You must prepare the homework solutions on your own, however. If you get answers to problems from your classmates but do not understand the material, it will be evident in your exam scores. The problems will (hopefully) span a range of difficulty; don't get discouraged if you can't always solve every part of every problem; you may ask questions about homework problems during office hours or in any extra time during class sessions (instructor will attempt to provide some time for this purpose during each class session). Partial credit will be given based upon the work you show, so it is important to include any relevant steps you have taken in your problem-solving process and or explanatory statements (if appropriate). If you are proficient at Latex, it is perfectly acceptable (and even encouraged) to submit solutions you have typeset in Latex, provided that the .tex files are submitted along with the pdf output.

Midterm (worth 20% of grade): The midterm exam will tentatively take place on the date listed in the schedule below, during a synchronous class zoom session. Although normal synchronous class sessions do not require students to turn their cameras on, **cameras are required to be on during exams, must show the student and the desk/table surface on which they are writing.** For privacy's sake, you are permitted to use a false background and keep your audio off. However, to ensure academic integrity during exams, video monitoring will take place, and sessions will be recorded. Students should expect these recordings will be reviewed by the instructor after the exam. You should test your device's capability to keep your camera on, and ensure that you are in a location with good connectivity, **in advance** of the exam. This is your responsibility; preventable technical failures may risk forfeiture of your exam. During each exam, students will log into Canvas, and begin taking the exam that will appear when the class time begins, and the exam will be timed. Students may use a calculator, scratch paper, and an equation sheet of their own making. After the exam, you will be asked to submit photos of your scratch paper and equation sheet.

Final Project (worth 20% of grade): During finals week, you will submit a project and participate in the peer-review process. The project will consist of a short final paper which will summarize the results of some phenomenon related to planets. More details about the topics and expectations for this paper will be provided at a later time; however, you can expect that one of the requirements will be to produce a "publication ready" paper that includes at least one plot, figure, or image, and a list of references. As part of your grade, you will also be required to submit a peer-review of three other students' papers. Your paper's grade will be partly determined by the peer reviews, but the final determination will be up to the instructor.

Final Exam(worth 20% of grade): The final exam will be comprehensive and will take place during finals week and will be conducted in a similar manner to the midterm exam. Once the University schedules the final exam slot, any scheduling conflict should be resolved by the student, and any unresolvable conflict must be brought to the attention of the instructor immediately.

Course Topics and Tentative Timeline:

- **Week 1 (Jan 19 & 21)**
  Introduction: Solar System and exoplanet overview
- **Week 2-3 (Jan 26 & 28 and Feb 2 & 4)**
  Dynamics: Dynamical behavior of planet systems
- **Week 4 (Feb 9 & 11)**
  Atmospheres: Physics of planetary atmospheres
- **Week 5-6 (Feb 16,18, 23, 25)**
  Terrestrial Worlds: Details of terrestrial planets and the Moon
- **Week 7-8 (Mar 2, 4, 9, 11)**
  Giant Worlds: Details of giant planets
  Midterm Exam: March 11
- **Week 9 (Mar 16, 18)**
  Minor Bodies: Minor planets, comets, asteroids, etc.
- **Week 10-11 (Mar 23, 25, 30 and Apr 1)**
  Exoplanets: Details of exoplanets
- **Week 12-13 (Apr 6, 8, 13, 15)**
  Formation: Planetary formation
- **Week 14 (Apr 20, 22)**
  Astrobiology: What planetary science tells us about extraterrestrial life
- **Week 15 (April 26-30)**
  Finals Week: Project due April 26 and Final exam TBA by University

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. For these reasons, it is unacceptable to harass, discriminate against, or abuse anyone because of race, ethnicity, gender, disability, religious affiliation, sexual orientation, or age. If you witness or are subject to such harassment, please report it to the instructor or to the Office of Diversity and Inclusion.

Disability Services:

If you have a disability that requires special testing accommodations or other classroom modifications, you need to notify both the instructor and Disability Resources and Services no later than the second week of the term. You may be asked to provide documentation of your disability to determine the appropriateness of accommodations.