



UNIVERSITY OF CONNECTICUT

Department of Physics
College of Liberal Arts & Sciences

PHYS 2701 – Foundations of Modern Astrophysics **Course Syllabus, Fall 2019**

Syllabus information is subject to change. The most up-to-date syllabus is located within the course in HuskyCT.

Course and Instructor Information

Instructor: Professor Cara Battersby

Office: Gant South S113F

Email: cara.battersby@uconn.edu

Office Hours: Mondays 1:30-2:30pm, Wednesdays 4:00-5:00pm or by appointment: just ask me or try: meetingbird.com/meet/battersbot

Class Meeting: Mon/Wed 12:15-1:30pm

Class Location: GP110

(Highly) Recommended Course Materials

An Introduction to Modern Astrophysics by Carroll & Ostlie, 2nd edition, published by Pearson. Also known as the BOB (Big Orange Book) for reasons that will soon be obvious. The same textbook is used in both PHYS 2701 and 2702. A used copy is perfectly fine.

Course Objectives

Astrophysics is the study of the Universe, with a particular focus on stuff outside the Earth. In this course, you will learn how we know what we know about the universe, learn about what we don't know, and develop the skills and knowledge to begin to unravel the mysteries of the universe for yourself (cool, right?).

This course is the first in a 2-part sequence. PHYS 2701 will focus on the foundational physics concepts of light (production, transfer, properties), gravity, and orbits and the phenomenology of stars and planets. PHYS 2702 will focus on the techniques of astrophysics, with a subset of topics including telescopes, optics, statistics, and data analysis and the phenomenology of galaxies and cosmology.

Main objectives:

1) Develop and advance **critical thinking and problem solving skills** and apply them to astrophysical phenomena

- 2) Build a **foundational understanding** of astrophysical concepts (light, gravity, orbits, stars, and planets)
- 3) Get experience with **communicating scientific ideas**

Pre-requisites

The course assumes a strong background in physics and calculus. The PHYS 2701-2702 sequence is designed for students intending to pursue an astrophysics minor and its associated advanced astrophysics coursework. General science and engineering students who want a more challenging and quantitative introduction to the universe than presented in the general education introductory astronomy course (PHYS 1025) may also take the course, however, be aware that it will require a lot of hard work. Both PHYS 2701 and 2702 count as upper-level physics electives and count toward an Astrophysics Minor.

Course Schedule

Tentative Course Schedule -- subject to change – shared here:*

<https://preview.tinyurl.com/PHYS2701-Fall2019-Schedule>

| Date | Unit | Topic | Reference Reading | Assignment/Exam Notes | Notes |
|-------------------------|--------------------------------------|---|-------------------------------------|---------------------------|---|
| Monday, August 26 | 1 - Intro and Scales of the Universe | Intro, scales of the universe | | HW #1 assigned | First day of class |
| Wednesday, August 28 | 2 - Celestial Coordinates | The Sky at Night, Sidereal vs. solar time | Chapter 1 | | |
| Monday, September 2 | | Labor Day - no classes | | | No class |
| Wednesday, September 4 | 3 - Gravity | Gravity, Newton's laws, Kepler's laws | Chapter 2 | HW #1 due, HW#2 assigned | |
| Monday, September 9 | | Guest Lecture - Gravity, escape speeds, Kepler's laws | | | 9/9/19 is last date to add/drop courses, or place them as pass/fail |
| Wednesday, September 11 | | Guest Lecture - Lagrange points, virial theorem, parallax | | HW #2 due, HW #3 assigned | |
| Monday, September 16 | 4 - The Nature of Light | Electromagnetic Radiation | Chapters 3, 5 | | Brainstorm Astrobite Paper ideas |
| Wednesday, September 18 | | Magnitudes, Thermal radiation | | | |
| Monday, September 23 | | Blackbody radiation, Light and Matter | | HW #3 due, HW #4 assigned | |
| Wednesday, September 25 | | Kirchoff's laws | | | Finalize astrobite topic choice |
| Monday, September 30 | | Doppler, Spectral lines, deBroglie λ | | | |
| Wednesday, October 2 | | Bohr Model, Uncertainty, Zeeman | | HW #4 due, HW #5 assigned | |
| Monday, October 7 | Exam Take #1 | Exam week | | | |
| Wednesday, October 9 | Exam Take #2 | Exam week | | | |
| Monday, October 14 | 5 - Stellar Spectra and Atmospheres | Stellar spectra: Formation | Chapter 8 | | First astrobite draft due |
| Wednesday, October 16 | | Stellar spectra: Abundances | | HW #5 due | |
| Monday, October 21 | | Stellar atmospheres, H-R diagram | Chapters 8.2, 9.5 | | Second astrobite draft due |
| Wednesday, October 23 | | Opacity, mean-free path | Chapter 9.2, 9.3 | HW #6 assigned | |
| Monday, October 28 | | Radiative transfer, limb darkening | Chapter 9.2, 9.3, 9.4 | | 10/28/19 - Last day to drop a class |
| Wednesday, October 30 | 6 - Stellar Interiors and Evolution | Hydrostatic equilibrium | Chapter 10.1, 10.3 | | Extra credit for wearing an astro-themed costume! |
| Monday, November 4 | | Coloumb barrier and quantum tunneling | Chapter 10.3 | HW #6 due, HW #7 assigned | Final astrobite due. |
| Wednesday, November 6 | | Nuclear fusion in stellar interiors | Chapter 13 | | |
| Monday, November 11 | | Eddington limit, stellar evolution | Chapter 10.6, 13.2 | | Workshop presentations |
| Wednesday, November 13 | | Post - Main Sequence evolution | Chapter 13.2, 16.2, 13.3, 15.1-15.3 | HW #7 due, HW #8 assigned | |

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|----------------------------|--------------------------------------|--------------------------------------|------------|-------------------|---------------------------------|
| Monday, November 18 | 7 - Planets and Life in the Universe | Dust, gas, ISM, formation of planets | Chapter 12 | | Astrobite presentations, part 1 |
| Wednesday, November 20 | | Exoplanets! | Chapter 23 | HW #8 due | Astrobite presentations, part 2 |
| Monday, November 25 | | Thanksgiving Recess - No class | | | No class |
| Wednesday, November 27 | | Thanksgiving Recess - No class | | | No class |
| Monday, December 2 | | Exoplanets! | Chapter 23 | | |
| Tuesday, December 3 | 6pm-8pm | REVIEW SESSION! | | | |
| Wednesday, December 4 | | Mock Final Exam | | Final Exam, try 1 | Mock exam |
| 12/9/19-12/15/19 | | Final Exam Week | | Final Exam, try 2 | Final exam |

Grading and Course Work

This course is designed to reward hard work and in-class participation. Intelligence is fluid and learning to learn is an important component of this class.

| Grade Component | Weight |
|------------------------|--------|
| Homework and Quizzes | 35% |
| Midterm Exam | 20% |
| Final Exam | 25% |
| In-class participation | 10% |
| Astrobite and pop talk | 10% |

| Grading | Scale | (%) | |
|---------|-------|-------|----|
| 93-100 | A | 73-76 | C |
| 90-92 | A- | 70-72 | C- |
| 87-89 | B+ | 67-69 | D+ |
| 83-86 | B | 63-66 | D |
| 80-82 | B- | 60-62 | D- |
| 77-79 | C+ | 0-59 | F |

Exams

In an effort to minimize stress, maximize learning, and offer you the opportunity to demonstrate your learning, rather than exam-taking skills, each exam will be offered *twice (different versions)*, first as a mock-exam, then as a regular exam. You can take the best grade of the two. Students should contact the instructor at the beginning of the semester for any planned absence.

The midterm exams (mock and regular) will be *Monday ***Oct. 7th and Wednesday Oct. 9th. (change from original schedule of Mon. Oct. 14 and Wednesday Oct. 16).*** The mock final exam will be Wednesday, Dec. 4. The regular final exam will be during final exam week.* Final exam week for Fall 2019 takes place from Monday, December 9th through Sunday, December 15th. Students are required to be available for their exam during the stated time. If you have a conflict with this time, you must visit the Dean of Students Office to discuss the possibility of rescheduling this exam.

Homeworks and Quizzes

Homeworks will be due roughly every 1-2 weeks. *Homework must be highly legible and on white paper with no binder edges. Place your name and problem number on **each page** and the final set should be stapled, with the cover sheet (provided) on top.* Collaboration on homework problems is allowed (even encouraged!), but the final written work must be your own. **Clearly indicate with whom you worked on each homework on the front page, what resources you used, and how long the homework took you.**

*Homeworks are due at the beginning of class. Since we will discuss homework solutions in class, no late homeworks can be accepted. **Each student's lowest homework score will be dropped.*** Students should contact the instructor at least one week in advance to make up work associated with planned absences (like religious observances or extracurricular activities).

The expectation for homework, and other written work, is that you clearly state the problem, demonstrate what you are calculating and why, clearly outline the steps and process for solving the problem, box your final answer, include appropriate units and significant figures for your answer, and assess the reasonableness of your answer. The focus is on problem-solving skills, not getting the right numerical answer, and the clearer your work is, the easier it is to assign partial credit. However, a “reality check” on your numerical answer is expected (does this answer make sense? Why or why not?).

Prof. Battersby has a **ZERO-TOLERANCE CHEATING POLICY**. You are absolutely forbidden from seeking homework answers online, posting homework questions online, copying from anyone, or any other form of cheating. If you do so, the incident will be reported to academic misconduct, and Prof. Battersby will recommend failure of the course.

For each problem set, there will be an in-class quiz on the day the homework is due, on one of the homework problems. This is to give you practice with working on your own in an ‘exam-like’ environment that is low pressure, since you know the questions ahead of time, as well as to ensure that you understand the problem set you completed. Therefore, please ask any questions that you have about the homeworks ahead of time!

The written homework will be “spot-graded” meaning that I will only grade a few questions. We will have time to discuss the solutions and any questions in class and of course in office hours. The Quizzes will comprise 25%, the graded homework questions will comprise 65%, and “completeness” of your homework will comprise 10% of the “Homeworks and Quizzes” portion of your grade.

In-class activities

This class will be an active learning experience with a lot of in-class work and participation expected. By default, *3 missed days of participation will be forgiven*, any more will detract from the in-class participation grade. Participation includes in-class group work, individual in-class work, answering and asking questions, volunteering to work through problems on the board, and general participation. Each day, you can earn 0, 1, or 2 points for no participation, distracted participation, or full participation, respectively.

Astrobite and Pop Talk

There is no way we can cover all of the amazing things in the universe in one semester, but I want you to have the opportunity to dive into an astrophysics topic that interests you and to share it with the rest of us. Moreover, no matter what profession you go into (astrophysics, teaching, lab manager, science policy, data science, etc) being able to research and clearly communicate what you find, both in written and spoken words, is an invaluable skill. Astrophysics is not stale and unchanging, scientists are discovering new things about the Universe every day. While much of this course will focus on fundamental properties of our Universe discovered decades or centuries ago, I want you each to have some first-hand experience reading and learning about cutting-edge astrophysics research.

To this end, you will have a semester-long project to research an astrophysics topic that interests you (topics will need to be approved by instructor), write a short “astrobite” on it, workshop the piece with classmates, revise, and submit. You will then practice presentation skills by workshopping a “pop talk” with a group in class on this topic and then, near the end of the semester, you will give a very short “pop talk” to the class on this topic.

You can find examples in the original astrobites (<https://astrobites.org>) or AAS Nova (<http://aasnova.org>). Your astrobite should be less than about 1000 words (1005 is okay, but don't push it) with references clearly documented. We will go over some example pop talks later in the semester, but it should be clear, exciting, short (< 3 minutes) with no slides or just a few good graphics (very little text).

Extra Credit

I encourage you to attend astronomy seminars (most Wednesdays 2pm) and Physics Colloquia (Fridays 3:30pm). If you attend at least three of these and hand in a short, 1 paragraph summary of each, you will be awarded extra credit, up to an additional 5% of your final exam. If you wear an astro-themed costume on Halloween, er, Oct. 30th (and show off your costume in front of the class!) you will be awarded an additional 10% extra credit on your most recent homework assignment.

General Rules of Conduct

Silence all cell phones when entering class. People sometimes forget that their instructors are people, not TV screens. If you're texting, yes we can see it, and yes, it is rude. You may be asked to leave class for repeated distractions caused by electronic devices.

You are welcome to use a laptop to take notes during lecture and for group work. However, all laptop users will be asked to sit in the front and center of the class.

Academic Integrity

Don't cheat. Not even once, not even a little bit. Academic honesty is a fundamental tenet of education. Copying someone else's work, letting someone copy yours, seeking or using homework solutions or old exams (found online, from a friend, *anywhere*) is

cheating. If any of you are caught cheating in any way, Prof. Battersby will report the incident to Academic Misconduct and recommend failure of the course.

Take responsibility for your learning process and be a part of the community of scholars at UConn. Similarly, plagiarism in any form, meaning the failure to adequately document the source(s) of one's work, is wrong. Both copying and plagiarism violate the UConn Student Code. See Appendix A: Academic Integrity in Undergraduate Education and Research: <http://community.uconn.edu/the-student-code-appendix-a/>

Instances of copying or plagiarism will be handled under the guidelines specified in the Student Code (<http://community.uconn.edu/the-student-code-preamble/>). You are responsible for acting in accordance with this code. Review and become familiar with these expectations. "I didn't know" is not an excuse. Please note that copying another student's assignment is not the same as sitting down in a study group and discussing the assignment. As long as you maintain the boundary of *doing your own work* following discussion, there should not be a problem.

All lectures, notes, handouts, homeworks, exams, quizzes, and displays are copyrighted by state and federal law. You are welcome to take notes and share them with other students in the class. You are not authorized to share course materials outside our class, and are expressly forbidden from commercial use of course materials.

UConn policies

Full UConn policies can be found on the web, here is a good place to start: <http://provost.uconn.edu/faculty-and-staff-resources/syllabi-references/>

Policy Against Discrimination, Harassment and Related Interpersonal Violence

The University is committed to maintaining an environment free of discrimination or discriminatory harassment directed toward any person or group within its community – students, employees, or visitors. Academic and professional excellence can flourish only when each member of our community is assured an atmosphere of mutual respect. All members of the University community are responsible for the maintenance of an academic and work environment in which people are free to learn and work without fear of discrimination or discriminatory harassment. In addition, inappropriate amorous relationships can undermine the University's mission when those in positions of authority abuse or appear to abuse their authority. To that end, and in accordance with federal and state law, the University prohibits discrimination and discriminatory harassment, as well as inappropriate amorous relationships, and such behavior will be met with appropriate disciplinary action, up to and including dismissal from the University. Additionally, to protect the campus community, all non-confidential University employees (including faculty) are required to report sexual assaults, intimate partner violence, and/or stalking involving a student that they witness or are told about to the Office of Institutional Equity. The University takes all reports with the utmost seriousness. Please be aware that while the information you provide will remain private,

it will not be confidential and will be shared with University officials who can help. More information is available at equity.uconn.edu and titleix.uconn.edu.

Students with Disabilities

The University of Connecticut is committed to protecting the rights of individuals with disabilities and assuring that the learning environment is accessible. 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. Students who require accommodations should contact the Center for Students with Disabilities, Wilbur Cross Building Room 204, (860) 486-2020 or <http://csd.uconn.edu/>

Accommodation will help ensure that all students have the opportunity to do their best work and optimize their academic experience.

Inclement weather and emergency preparedness

In case of inclement weather, a natural disaster, or a campus emergency, the University communicates through email and text message. Students are encouraged to sign up for alerts through <http://alert.uconn.edu>. Students should be aware of emergency procedures, and further information is available through the Office of Emergency Management at <http://publicsafety.uconn.edu/emergency/>

Sexual Assault Reporting Policy:

To protect the campus community, all non-confidential University employees (including faculty) are required to report assaults they witness or are told about to the Office of Diversity & Equity under the Sexual Assault Response Policy. The University takes all reports with the utmost seriousness. Please be aware that while the information you provide will remain private, it will not be confidential and will be shared with University officials who can help. More information is available at: <http://sexualviolence.uconn.edu/>