

SYLLABUS
Astronomy 300A: Dynamics in Astrophysics
The University of Arizona, Spring, 2022

Contact Details:	Peter Behroozi (Instructor)	and	Stefan Evans (TA)
Help Session Room:	Online		Online
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Pronouns:	he/him/his		he/him/his
Help sessions:	Thursdays 1-2pm		TBA

DATES/TIMES: Lectures will be delivered in **Steward 204 from 9:30-10:45am**; all lectures will also be recorded. All students must follow UA health and safety guidelines, including guidelines for wearing masks.

Information contained in the course syllabus, other than the grade and absence policy, may be subject to change with advance notice, as deemed appropriate by the instructor.

COURSE DESCRIPTION:

After this course, you will feel ready to take on any problem in the Universe. Literally. We will cover: 1) ways to estimate answers without solving complex equations (dimensional analysis); 2) orbits of stars, planets, and galaxies; 3) atmospheres; and 4) fluid dynamics. This course is a community of learners: those who grasp material earlier have the responsibility to help teach it to others.

LEARNING OUTCOMES:

Upon successful completion of the course, you will be able to:

- improve your skills and confidence for problem-solving;
- improve your ability to teach scientific concepts to others;
- solve any gravitational orbit problem involving up to 10^6 objects;
- describe and derive how dynamical phenomena arise, including chaos, resonances, rotation curves, and tidal disruption;
- solve for fluid equilibria and dynamical motion;
- describe and derive fluid phenomena, including sound speeds, Jeans instabilities, and convection.
- improve your awareness of career opportunities and ethical responsibilities as a scientist.

These learning outcomes will be met through the attendance of lectures, in-class and out-of-class assignments, quizzes, and a final exam.

MEET THE TEACHERS:

Courses exist to be useful for students. To help make this course more useful and relevant to you, we would like to have virtual 15-minute meetings with pairs of students during the second week of the semester until we've met with everyone. We want to learn more about your interests and career goals, as well as to make it easier for you to reach out when you have questions. Our goal is also for you to be (and feel) valued as a human in our class, as opposed to you feeling unknown and anonymous.

IN-CLASS ACTIVITIES:

Many classes will contain an in-class group activity to allow you to put into practice the concepts that you are learning. You will be required to turn in these activities on D2L whether attending the class synchronously or not; they will form 25% of the class grade. Students watching recorded lectures are encouraged to form their own groups (e.g., via the class forum on D2L) to reduce the amount of work they have to complete on their own. Your lowest 3 in-class assignments will be automatically dropped.

HOMEWORK:

Homework assignments will occur every week, and will make up 25% of your grade. You are strongly encouraged to work in groups: this will help you to keep a regular homework schedule and will help you learn new ways of problem-solving (or teaching) from your peers. Homeworks are due one week from the posting date; if you need more time, you are welcome to request it. Your lowest homework assignment will be automatically dropped.

HELP SESSIONS/FORUMS:

Help sessions will occur every week, and we strongly encourage you to take advantage of them. We both want you to succeed! Each time you attend a help session and participate, we will increase your average homework grade by 1%, up to a maximum of 10%. You may also ask questions (and answer your peers' questions) on the forums. If you ask or answer a question on the forum, you will get the same homework grade bonus as if you had attended a help session. Help is also available via ATOMM ([Astronomy Tutoring Offered for Majors and Minors](#)), which will also give the same bonus.

QUIZZES:

Several short, quizzes will occur throughout the semester. These will be announced in class, at least a week in advance. All quizzes will be take-home, and you will be expected to work independently. Quizzes will contribute 25% of your final grade; your lowest quiz grade will be automatically dropped.

FINAL EXAM:

The final exam will be an open-book, take-home exam that will cover material from the entire course. The exam will be distributed by Friday, May 6, and will be due by 11:59pm on Friday, May 13. It will make up 25% of your grade. As with the quizzes, you will be expected to work independently.

In the course of the semester, there will also be two Mega-Challenges announced. Successfully completing one of these two challenges will allow you to skip the final exam (i.e., you would receive the equivalent of a perfect score on the final).

GRADES:

If you turn in all homework assignments and your average course grade is:

- 87% or better: A
- 72% or better, but less than 87%: B
- 50% or better, but less than 72%: C
- 30% or better, but less than 50%: D
- Less than 30%: E.

If you feel like you are working hard in the course but are not getting at least a C, please come talk! We don't want you to struggle in silence. As a reminder, the grading weights are: in-class activities (25%), homeworks (25%), quizzes (25%), and final exam (25%).

REQUIRED TEXT AND READINGS:

We will use two textbooks in this class, both of which are available online for free. For earlier classes on gravity, we will use *Principles of Astrophysics* (PA) by Charles Keeton. For later classes on fluid dynamics, we will use *The Tapestry of Modern Astrophysics* (TMA), by Steven Shore.

COURSE WEBSITE:

We will use D2L to distribute course notifications and assignments, as well as for turning in assignments. It is your responsibility to check D2L regularly.

SCHEDULE:

Subject to change, depending on the time it takes to cover materials in class.

Dates	Topics	Reading
Jan. 13, 18	Syllabus, Dimensional Analysis	N/A
Jan. 20, 25	Elliptical Orbits	PA, Chapter 3
Jan. 27, Feb. 1	Non-Elliptical Orbits	PA, Chapter 3
Feb. 3, 8	Two-body Problems	PA, Chapter 4
Feb. 10, 15	Tides	PA, Chapter 5
Feb. 17, 22	Three-body Problems	PA, Chapter 6
Feb. 24, Mar. 1, 3	N-body Problems	PA, Chapter 8
Spring Break		
Mar. 15, 17	Resonances/Mass Transfer	PA, Chapter 6
Mar. 22, 24	N-body Statistics	N/A
Mar. 29, 31	General Relativity	PA, Chapter 10
Apr. 5, 7	Galaxy Mergers	PA, Chapter 8
Apr. 12, 14	Atmospheres	PA, Chapter 12
Apr. 19, 21	Fluid Motion	TMA, Chapter 1.4
Apr. 26, 28	Jeans Instabilities, Convection	N/A
May 3	Make-up & Course Review	N/A
May 6 - 13	Final Exam	N/A

ACADEMIC HONESTY

We follow the policies outlined in the Dean of Students code of academic integrity, including cases of plagiarism and cheating (see <http://deanofstudents.arizona.edu>). We encourage you to work with your peers on the homeworks. Such collaborations can include a discussion of the qualitative concepts and on the quantitative aspects (i.e., whether you get the same conclusions), but in the end you must do your own work. Academic honesty also extends to printed texts, websites, and video content. If an assignment even only *appears* to be copied from someone else, or copied from a source without a reference, or copied from a referenced source and only a few words changed, then the assignment will be assumed to be plagiarized. We will give a grade of “E” for the assignment, and this may further lead to you receiving an “E” for the course.

ATTENDANCE AND CLASSROOM ETIQUETTE

Students are expected to attend all lectures. Please turn off cell phones in class, and refrain from extraneous talking, distracting/discourteous behavior, and coming late and/or leaving early. **For any occurrences where you know you will have to come late or leave early, please let us know in advance.**

The UA 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>.

The UA Threatening Behavior by Students Policy 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>.

The University is committed to creating and maintaining an environment free of discrimination and harassment; see <http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy>.

ASSISTANCE

We are here to help you, so please take advantage of help sessions. We also want to get to know you, so you are very welcome to set up a time to introduce yourself. Please contact us promptly if you have any questions or concerns regarding this class.

If you anticipate barriers related to the format or requirements of this course, please meet with us so that we can discuss ways to ensure your full participation in the course. If you determine that disability-related accommodations are necessary, please register with Disability Resources (621-3268; <https://drc.arizona.edu/>) and notify us of your eligibility for reasonable accommodations. We can then plan how best to coordinate your accommodations.

The University of Arizona provides a wide variety of resources to help you feel more at home in the UA environment. Examples of student resource/cultural centers include:

- The [African-American Student Affairs Center](#)
- The [Asian & Pacific American Student Affairs Center](#)
- The [Counseling and Psych Services Center](#)

- The [Guerrero Student Center](#)
- The [Immigrant Student Resource Center](#)
- The [LGBTQ+ Student Affairs Center](#)
- The [Native American Student Affairs Center](#)
- The [Think Tank Tutoring Center](#)
- The [Transfer Student Center](#)
- The [Veterans Education and Transition Services Center](#)
- The [Women & Gender Resource Center](#)

We encourage you to take advantage of the community, support, and learning opportunities afforded by these centers, and to encourage your friends and colleagues to do the same.