

## Ay 21 Galaxies and Cosmology - Winter 2025

**Instructor:** Prof. S. George Djorgovski, [djorgovski@caltech.edu](mailto:djorgovski@caltech.edu), 374 Cahill  
Office hours: contact the instructor

**TA:** Harshda Saxena, [hsaxena@caltech.edu](mailto:hsaxena@caltech.edu), 250 Cahill  
Office hours: Wed 5:30 pm, 219 Cahill

**Class Website (not Canvas!):** [tinyurl.com/ay21class](https://tinyurl.com/ay21class)  
Everything except the homework and exams will be posted there.

**Lectures** (attendance is *highly recommended*): Mon & Wed, 2-2:55 pm, 219 Cahill.

**Recitation section** (attendance is *required*): Fridays, 2-3 pm, 219 Cahill.

**Course Description, updated from the Catalog:** Ay 21. Galaxies and Cosmology. 9 units (3-0-6): second term. Prerequisites: Ma 1 abc, Ph 1 abc, Ay 20 (or at least Ay 1). Intended for Sophomores, open to Juniors and Freshmen (with the instructor's permission); not open to Seniors. Cosmological models and parameters, extragalactic distance scale, cosmological tests; constituents of the universe, dark matter, and dark energy; thermal history of the universe, cosmic nucleosynthesis, recombination, and cosmic microwave background; formation and evolution of structure in the universe; galaxy clusters, large-scale structure and its evolution; galaxies, their properties and fundamental correlations; formation and evolution of galaxies, deep surveys; star formation history of the universe; quasars and other active galactic nuclei, and their evolution; structure and evolution of the intergalactic medium; diffuse extragalactic backgrounds; the first stars, galaxies, and the reionization era. Instructor: Djorgovski.

**About this class:** The class will consist of two weekly lectures and one weekly recitation section. New lectures will be slightly updated versions of the previously recorded lectures (in Winter 2024), and the videos are linked on the class website. Copies of the current slides, and other useful links will be posted on the class website as we go along. You can watch the lecture videos at your convenience, but we strongly recommend that you do that before the office hours and the recitation section. You can also ask us questions about anything that is not clear by email, not waiting for the office hours. Our goal is to help you learn, but you are doing the learning.

**Attendance and Participation:** The attendance of the lectures is highly recommended, but not strictly mandatory; however, the attendance of the recitation section is required, and we'll subtract 1% from your total score for every missed recitation section, unless you have a very good excuse. If you cannot attend it for some reason, please contact the instructor or the TA beforehand. Your active participation in the lectures and recitation section (asking questions, answering them, etc.) will be a part of your grade.

**Textbook:** There is no *required* textbook; the lectures (videos and slides) are your de facto textbook. They will be available at the [class website](#). However, there is a supplementary textbook, that is free to access for the Caltech students:

"*Extragalactic astronomy and cosmology: an introduction*", by Peter Schneider, QB857.5.E96 S36 2006, Springer, any edition, ISBN-13: 978-3642540820, ISBN-10: 3642540821  
Caltech students have [a free access to an online version](#)

In addition, *useful links* to other relevant websites, articles, and reviews are posted on the class website. Another *optional, but useful* book is "Introduction to Cosmology", by Barbara Ryden, the 2nd edition in particular: QB981 .R93 2017, Cambridge Univ. Press, 2017. Multiple copies are available in our library if you can get them.

**Grading:** 20% homework + 30% midterm + 40% final + 10% classroom participation

**Late homework penalty:** –50% per day or a fraction thereof. We will give indulgences only for the really good reasons (sickness, if you have a note from the doctor or the Dean; death in the immediate family; being abducted by a UFO, with a convincing proof; etc.). No late exams will be accepted, except for the serious health related reasons. The **classroom participation** refers to the activity during the summary lecture, recitation section, office hours: ask questions, answer the questions, etc. - that is how we know that you are actually paying attention.

### **Collaboration Policy:**

**Homeworks:** Discussion of the homework problems and how to solve them is encouraged. However, intermediate work and the final solution have to be done individually and cannot be shared. You can use any materials you want, except any problem solutions from the previous years.

**Midterm and Final:** *No collaboration or discussion is allowed*, and everyone has to turn in their own solutions. You cannot consult any notes or other materials once you start the exam; study and prepare beforehand. You also cannot discuss the exam with anyone, until the solutions are posted.

### **Academic Integrity:**

**Caltech's Honor Code:** "No member of the Caltech community shall take unfair advantage of any other member of the Caltech community."

**Understanding and Avoiding Plagiarism:** Plagiarism is the appropriation of another person's ideas, processes, results, or words without giving appropriate credit, and it violates the honor code in a fundamental way. You can find more information at: <https://writing.caltech.edu/resources-for-writers/understanding-and-avoiding-plagiarism>.

All instances of plagiarism or other academic misconduct will be referred to the [Board of Control](#) for undergraduates. For graduate students, contact the [Graduate Office](#).

### **Wellness Policy:**

- Taking care of your health and well-being should be your number one priority. You cannot learn if you are unwell or under extreme duress.
- The course work should feel challenging in a positive way, but we do not want you to be overwhelmed by your work for this course.
- If you find yourself overwhelmed or encountering other personal challenges during the term, please reach out to me so we can develop a plan for you to pursue success in this course in a healthy way. In addition, I encourage you to utilize Caltech's resources (see below).
- I am available to chat, and you can always attend office hours for a non-academic conversation if necessary. You can also visit the counseling center or talk to the Dean if you find you need help beyond the course staff.

- All participants in this course must be treated with respect by others in accordance with the honor code. If you feel unwelcome or unsafe in any way, no matter how minor, I encourage you to talk to me or one of the Deans.

*If you would like to ask about flexibility with coursework for a temporary or minor wellness issue, please contact the Instructor directly.* The Deans' Office, Student Wellness Services (SWS) and Caltech Accessibility Services for Students (CASS) are available to help you with illness and health conditions that may impact your coursework:

- [Student Wellness Services](#) will assess and treat illnesses and medical conditions, and communicate (with student's permission) with the Deans' Office if CASS, part of SWS, can recommend and provide for accommodations needed due to temporary or long-term disabilities. Policies about academic extensions for medical reasons can be found at the Wellness Services website.
- [The Deans' Office](#) may recommend academic exceptions in cases of significant family or personal emergencies, or moderate to severe illness or medical conditions that make it difficult to keep up with coursework. Please reach out to the Dean as soon as possible if you experience these conditions.

**Students with Documented Disabilities:** Students who may need an academic accommodation based on the impact of a disability must initiate the request with Caltech Accessibility Services for Students (CASS). Professional staff will evaluate the request with required documentation, recommend reasonable accommodations, and prepare an Accommodation Letter for faculty dated in the current quarter in which the request is being made. Students should contact CASS as soon as possible, since timely notice is needed to coordinate accommodations. For more information: <http://cass.caltech.edu/>, [cass@caltech.edu](mailto:cass@caltech.edu).

**Discrimination and harassment:** As a faculty member, I am required to notify the Institute's Equity and Title IX Office when I become aware of discrimination, sexual harassment, or sex- or gender-based misconduct involving our community members. If one of my students shares such an experience with me, I can help connect them to support resources but will not be able to keep that information confidential as part of fulfilling my responsibility to make sure my students are offered the opportunity to access information and support by the Institute. For more information, you can email [equity@caltech.edu](mailto:equity@caltech.edu), go to [equity.caltech.edu](http://equity.caltech.edu), or review the Institute's [Sex- and Gender-Based Misconduct Policy](#).

If you have experienced such prohibited conduct and would like confidential support, please feel to contact Student Wellness Services [626-395-8331; <https://wellness.caltech.edu/counseling>]; Taso Dimitriadis, Center for Inclusion and Diversity [626-395-8108; [taso@caltech.edu](mailto:taso@caltech.edu)]; or Teresa Mejia, Campus Sexual Violence Advocate [626-395-4770; [teresam@caltech.edu](mailto:teresam@caltech.edu)].

### **Resources for Students:**

- Online Learning: Resources, FAQs, and more for students learning online; <http://learn.caltech.edu>
- Tutoring: The undergraduate dean's office provides a peer tutoring service; If the course isn't listed, students can talk with the dean's office to arrange for a tutor; <http://deans.caltech.edu/>
- Writing: The Hixon Writing Center provides professional writing tutors as well as peer tutors, individual and group writing space, and additional resources; <http://writing.caltech.edu/>

- Registrar & FERPA: The registrar can answer questions about degree progress, privacy of student records, and course enrollment procedures; <http://registrar.caltech.edu/>. The website also lists Option Representatives for option-specific advising, policies, and information.
- Library: Borrow books, retrieve journal articles, receive guidance about research; <https://www.library.caltech.edu/>
- Dean of Undergraduate Students: Wide-ranging assistance addressing issues (academic and other) for undergraduates; <http://deans.caltech.edu/>
- Dean of Graduate Studies: Wide-ranging assistance addressing issues (academic and other) for graduate students; <http://gradoffice.caltech.edu/>
- Student Wellness Center: Wide variety of health and wellbeing services; <https://wellness.caltech.edu/>
- Counseling Services: Free for all students, regardless of insurance plan; <http://counseling.caltech.edu/>
- Occupational Therapy: Individual sessions and consultations on building healthy habits and routines, time management, planning and organization, and more. Free for all students; <http://ot.caltech.edu/>
- Caltech Accessibility Services for Students: Deans work with students with physical and learning disabilities on accommodation requests and services; <http://cass.caltech.edu/>
- Residential Support: Resident Associates (RAs) and Residential Life Coordinators (RLCs) are also resources for TAs and students; <http://www.residentialexperience.caltech.edu/>
- Career Development Center: Provides resources to help students make career decisions and implement career plans; <http://www.career.caltech.edu/>