AST 386C (Unique 48050, Fall 2022)
"Properties of Galaxies"

Welcome to AST 386C ("Properties of Galaxies"), a course designed for graduate students in astronomy and astrophysics and taught by Professor Shardha Jogee. This class website is the one-stop shop where announcements and the vast majority of class materials (e.g., copies and video recordings of lectures, homeworks and other assignments, zoom links) will be posted, so please bookmark it and visit it regularly. You will need the id and password given in class to access some of the secure materials on the website.

We continue to face an unprecedented pandemic that is challenging our learning, teaching, and research activities. Please remember that we are all in this together and it is important that we all show extra compassion, empathy and flexibility while everyone navigates different individual challenges. As the professor in this class, I aim to support you in every way I can, so please do not hesitate to reach out to me (email: sj@astro.as.utexas.edu) if you are facing challenges. To help us provide safe in-person classes, please follow the Classroom Safety and COVID-19 Policy.

Below are some quick links for frequently accessed parts of this website.

- Repository of Selected Material from Lectures & Assignments
- Course outline/calendar
- Course Prerequisites
- Course Description and Goals
Course Syllabus and Overview

Course Prerequisites: This class is designed for graduate students in astronomy and astrophysics. The class pre-requisites are: (1) Standard undergraduate level physics and mathematics preparation; (2) Undergraduate-level astronomy background on the properties, structure, and evolution of stars. If you have not taken Astronomy courses on the latter topics before, please review the material in the Appendix of "Extragalactic Astronomy and Cosmology" by Peter Schneider, Copyright 2006, Springer. If you do not have some of the required pre-requisites it is your responsibility to review and master the material above and to contact the professor during the first week of class so she can help you. Some useful mathematical background is also posted from Appendix B of "Galactic Dynamics" by J. Binney and S. Tremaine, Second Edition, Copyright 2008, Princeton University Press.

Course Description and Goals: AST 386C ("Properties of Galaxies") is designed for graduate students in astronomy and astrophysics. This core course covers the fundamental properties of galaxies and focuses on using the laws of physics to interpret observations and understand how galaxies form and evolve. Topics to be covered typically include the properties and constituents of galaxies (e.g., the morphology, structure, star formation, black holes, gas content, dark matter, etc); the evolution of galaxies across time and environment; the factors driving the growth and transformation of galaxies (e.g., galaxy interactions and mergers, secular processes, gas accretion, environmental effects, and feedback from stars and AGN); and challenges to current hierarchical Lambda CDM-based paradigms of galaxy evolution.

Course Calendar: The course outline/calendar provides an approximate sequencing of topics to be covered in class. There may be schedule adjustments based on the learning curve of the class and circumstances tied to the pandemic or other emergencies. The course outline will be updated regularly and the most current version can be found on the class website at the above link. Note that as per departmental policy, the professor is a professional astronomer and researcher who has professional responsibilities and may be occasionally be away for reasons tied to these responsibilities (e.g., to participate in international scientific panels and meetings, to present research talks at conferences, etc). In such cases, there may be
a schedule change and an appropriate replacement lecture or other assignment will be scheduled.

**Textbook for Complementary Reading:** The lectures will include material drawn from a wide range of textbooks, as well as from published cutting-edge research results that have not yet made it to standard textbooks. In case you want to do supplementary reading, below are some recommended textbooks for complementary reading. When using these textbooks, you can use the book's appendix to locate specific sub-topics covered in a given lecture. These sub-topics are often spread across several chapters in the books, so there is no one-to-one correspondence between the class lectures and the book chapters.

- "Extragalactic Astronomy and Cosmology" (EAC) by Peter Schneider (Publisher: Springer, copyright 2006). Several desk copies of the textbook are on reserve for this class in the PMA library (on the 4th floor of PMA). As a UT student, you can also access a free electronic copy by going to the [UT library catalog link](https://www.as.utexas.edu/~sj/a386c-fa22/) and entering the book title. The UT PMA librarian indicates that students can download and print from this Springer book as the PDF files are digital rights management-free. If you want to purchase a hardcopy or electronic copy, please consider Google eBooks, Amazon, Springer or local bookstores:
  - "Galaxy Formation and Evolution" (GFE), by H. Mo, F. van den Bosch, and S. White, Copyright 2010, Cambridge University Press.
  - "Galaxies in the Universe: An Introduction" (GU), by Sparke & Gallagher (Publisher: Cambridge University Press, copyright 2000)

**Office Hours, Accommodations, and Other Useful Resources:**

The instructor for this class is [Professor Shardha Jogee](https://www.as.utexas.edu/~sj/a386c-fa22/). As the instructor, I aim to support you in every way I can, so please do not hesitate to get in touch with me if you are facing challenges and need help.

1. Office hours will be held at the times listed below or by appointment.

   Name: Prof. Shardha Jogee  
   Office: PMA 15.326  
   Hours: Th. 3:30 to 4:30 pm (or by appointment)  
   Email: sj@astro.as.utexas.edu

2. Beyond office hours, you can also email the professor if you need help. Please allow **up to one business day** for a response and note that emails sent after
business hours (Monday to Friday from 9:00 am to 5:00 pm when the University is open) or during the weekend may not receive an answer until the next business day.

3. **You All Belong Here:** We are here to support, welcome, and educate each and every student. A climate conducive to learning and creating knowledge is the right of every person in our community, and as per the UT Austin non-discrimination policy, we are committed to providing an educational and working environment that is free of unlawful discrimination, including discrimination on the basis of race, color, religion, national origin, sex, pregnancy, age, disability, citizenship, veteran status, and genetic information. If you experience inappropriate conduct from anyone in this class or anywhere on the UT campus, please contact the professor and consider reporting your concerns to one or more of the following units: the Office of the Dean of Students, the title IX office (for sexual harassment and misconduct), or BCCAL.

4. Students with disabilities or special circumstances may request appropriate academic accommodations from the UT Austin office for Disability and Access. If you have an emergency, please contact Student Emergency Services (SES) in the office of the Dean of Students.

**Class Attendance Policy**

This class will meet weekly in PMA 15.216B in-person (face-to-face) on **Tuesday and Thursday from 2:00 pm to 3:30 pm**. Please be on time as we need to end sharply at 3:15 pm, as per UT policy, and to allow the colloquium speaker to set up. Our policies for class modality, class attendance, and class conduct are outlined below, with the caveat that UT protocols may change if the pandemic situation evolves.

1. This class will be held in person (face-to-face) in PMA 15.216B with reduced social density. Students will get the most from this class and benefit from a stronger supportive community by attending in person. The instructor asks students to attend class in-person unless they have a valid reason as outlined under point 2 below. We also ask everyone to provide a safe and effective learning environment by following the Classroom Safety and COVID-19 Policy.

2. Students may ask the instructor to allow them to temporarily attend the class over zoom or miss class if they have a valid documented reason. Valid reasons include the following:
   - A student has a letter from the UT Austin office for Disability and Access, allowing remote attendance or absences.
Students who need to miss class or attend remotely due to a critical situation and/or medical or family emergency should ask Student Emergency Services (SES) to notify the instructor and they should let the instructor know that they have asked SES to provide a notification. Note that students are not required to reveal or document their health status to the instructor when requesting accommodations for illness or other absences. Instead, SES will collect their confidential documentation and confirm without revealing protected details. Medical emergencies include situations where a student has to self-quarantine or self-isolate due to COVID-19.

If students have to temporarily take the class on zoom, they should turn the zoom camera on and try to attend the class in synchronous mode (i.e., at the time it is offered). We will take attendance in person and over zoom to reward participation.

3. To provide added flexibility, we plan to display the slides on zoom during in-person lectures and to post zoom-recorded lectures on the class repository. However, we stress that these recordings will not capture the enriching in-class discussions and in-class activities. Therefore, zoom attendance should only be used temporarily and for one of the valid reasons outlined under point (2) above.

4. Please turn off your cell phone before the start of class unless you are using it to zoom into the class.

5. As per UT Austin policy, a student who misses classes or other required activities, including examinations, for the observance of a religious holy day should inform the instructor as far in advance of the absence as possible so that arrangements can be made to complete an assignment within a reasonable period after the absence.

### Classroom Safety and COVID-19 Policy

We are still facing an unprecedented pandemic that is challenging our learning, teaching, and research activities. Please remember that we are all in this together and it is important that we all show extra compassion, empathy and flexibility while everyone navigates different individual challenges. To promote a safe in-person learning environment, the university recommends the following:

1. Please adhere to university mask guidance. While the University does not have a mask mandate, masks are strongly recommended in crowded indoor spaces for both vaccinated and unvaccinated individuals. According to the national Centers for Disease Control and Prevention (CDC) masks can
help protect you from the COVID-19 coronavirus and prevent you from spreading it to others.

2. **COVID-19 vaccinations are widely available**, free and not billed to health insurance. The vaccines authorized by the U.S. Food and Drug Administration are safe, effective, and provide our best chance to have a safe in-person semester. The vaccines help protect against serious illness, hospitalization, and death, and reduce the risk of transmission to others. **All eligible UT students, faculty, and staff members are encouraged to get vaccinated and boosted.**

3. Please take advantage of testing options on campus, such as the [University Health Services Symptomatic COVID-19 Testing Center (UHS STC)](https://www.as.utexas.edu/~sj/a386c-fa22/) (for those with symptoms of COVID-19) or [UHS Proactive Community Testing](https://www.as.utexas.edu/~sj/a386c-fa22/) (for patients who are feeling healthy). Tests are fast and free.

4. Students who feel sick, develop COVID-19 symptoms, or/and test positive for COVID-19 should stay home, inform [University Health Services](https://www.as.utexas.edu/~sj/a386c-fa22/) and/or the Nurse Advice Line at 512-475-6877, and follow the [University Health Services Exposure Action Chart](https://www.as.utexas.edu/~sj/a386c-fa22/). They should also ask [Student Emergency Services (SES)](https://www.as.utexas.edu/~sj/a386c-fa22/) to notify the instructor and they should let the instructor know that they have asked SES to provide a notification. Note that students are not required to reveal or document their health status to the instructor when requesting accommodations for illness or other absences. Instead SES will collect their confidential documentation and confirm without revealing protected details.

5. Students who have had close contact with someone who tested positive for COVID-19 should follow the [University Health Services Exposure Action Chart](https://www.as.utexas.edu/~sj/a386c-fa22/).

6. Your mental health and holistic well being are very important. If you need mental health services please do not hesitate to take advantage of [the mental health resources for UT students](https://www.as.utexas.edu/~sj/a386c-fa22/) and other services offered by the university [Counseling and Mental Health Center](https://www.as.utexas.edu/~sj/a386c-fa22/).

7. [Behavior Concerns and COVID-19 Advice Line (BCCAL)](https://www.as.utexas.edu/~sj/a386c-fa22/) remains available as the primary tool to address questions or concerns from the university community about COVID-19.

8. We encourage everyone to help our UT community by using the [Protect Texas App](https://www.as.utexas.edu/~sj/a386c-fa22/) and visiting the [Protect Texas Together](https://www.as.utexas.edu/~sj/a386c-fa22/) site regularly.

**Course Assignments and Grading Policy**
Please submit your assignments on Canvas using the instructions provided unless otherwise indicated. Your grades will be posted online on Canvas. Please note the following class policies:

1. I strongly recommend that you attend class in person as you will benefit from the lectures, discussions and class activities. We will take attendance in person and over zoom to reward and track participation.

2. The final grade will consist of:
   - 45% Homeworks
   - 20% First Midterm exam
   - 20% Second Midterm exam
   - 15% Student talks and class attendance/participation or equivalent.
   Class attendance accounts for 5% of the grade.

3. When converting your final numerical scores to letter grades, I will use the scheme below or one that is more lenient.

<table>
<thead>
<tr>
<th>Letter Grade</th>
<th>Grade Points</th>
<th>Numerical Score (Rounded)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>4.00</td>
<td>91% to 100%</td>
</tr>
<tr>
<td>A-</td>
<td>3.67</td>
<td>86% to 90%</td>
</tr>
<tr>
<td>B+</td>
<td>3.33</td>
<td>81% to 85%</td>
</tr>
<tr>
<td>B</td>
<td>3.00</td>
<td>76% to 80%</td>
</tr>
<tr>
<td>B-</td>
<td>2.67</td>
<td>71% to 75%</td>
</tr>
<tr>
<td>C+</td>
<td>2.33</td>
<td>66% to 70%</td>
</tr>
<tr>
<td>C</td>
<td>2.00</td>
<td>61% to 65%</td>
</tr>
<tr>
<td>C-</td>
<td>1.67</td>
<td>56% to 60%</td>
</tr>
<tr>
<td>D+</td>
<td>1.33</td>
<td>51% to 55%</td>
</tr>
<tr>
<td>D</td>
<td>1.00</td>
<td>46% to 50%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D-</td>
<td>0.67</td>
<td>41% to 45%</td>
</tr>
<tr>
<td>F</td>
<td>0.00</td>
<td>0% to 40%</td>
</tr>
</tbody>
</table>

4. Late homeworks will be accepted for partial credit provided that you have been granted an extension prior to the due date. In that case we will apply a 10% deduction for every 24 hours (e.g., a homework submitted 12 hours late will have a 5% deduction and receive 95% credit). Requests for correction or re-grade of an assignment (homework, exam or quiz) will be accepted at latest two weeks after it is handed back to you.

5. I will offer at least ane extra credit option for students to improve their grades.

6. **Cheating will be severely punished** and I will consider filing a report to the Office of the Dean of Students for any student who cheats. If you submit work that is not primarily done by you or/and that you cannot explain, this will be considered as cheating. If you copy someone's assignment, exam, or quiz or if
you let someone copy yours, both of you will receive zero credit and be responsible for cheating. In particular, note that you must independently write up your assignments and you must be able to explain every step of your work if asked to do so. You are encouraged to study with other students as long as you abide by this principle. If you use a private tutor to help you, please make sure that the bulk of each assignment is done by you and that you can explain every step of your work if asked to do so. The TA and professor reserve the right to ask any student to explain his/her answers and methodology on any assignment before assigning a final score for that assignment.

7. **Sharing of Course Materials is Prohibited:** No materials used in this class, including, but not limited to, lecture hand-outs, videos, assessments (quizzes, exams, papers, projects, homework assignments), in-class materials, review sheets, and additional problem sets, may be shared online or with anyone outside of the class unless you have the instructor’s explicit, written permission. Unauthorized sharing of materials facilitates cheating. It is a violation of the University’s Student Honor Code and an act of academic dishonesty. UT is aware of the sites used for sharing materials, and any materials found online that are associated with you, or any suspected unauthorized sharing of materials, will be reported to Student Conduct and Academic Integrity in the Office of the Dean of Students. These reports can result in sanctions, including failure in the course.

8. **Academic Integrity and the University Code of Conduct:** All students are expected to uphold academic integrity and abide by the core values of the university – learning, discovery, freedom, leadership, individual opportunity, and responsibility. Academic integrity expectations are outlined in Section 11-402 of the Institutional Rules on Student Services and Activities. Since academic integrity promotes the growth, development, and success of all students and the university, policies on academic integrity will be strictly enforced. Academic dishonesty includes but is not limited to cheating, plagiarism, unauthorized collaboration, falsifying academic records, misrepresenting facts, and any other acts that violate the basic standard of academic integrity. Consequences of academic dishonesty can be severe: grade-related penalties are routinely assessed, but students can also be suspended or even permanently expelled from the University for scholastic dishonesty.

---

**Selected Material from Lectures/Assignments**

The repository below will be updated throughout the semester with important class materials (e.g., video recordings of zoom lectures; pdf versions of powerpoint...
Presentations made during the lecture; scans of materials that would usually be handwritten on the blackboard or document camera; homeworks and other assignments). However, I strongly recommend that you do not only rely on this posted material and do your best to attend class in synchronous mode (i.e., at the time it is offered) so that you can benefit from in-class discussions and activities.

- **Course Syllabus on day 1 of class**

---

**Extra Class Resources**

- NASA ADS Abstract Services:
  - [Public Link for Classic NASA/ADS form](https://www.nasa.gov/) (This allows you to find papers and access abstracts, but you may not be able to download the full papers from journals that require subscriptions)
  - [UT library subscription eproxy link for Classic NASA/ADS form](https://www.utexas.edu/) (This allows you to find papers, access abstracts, and download full paper from journals for which UT has a subscription.)

- [Astrophysics Preprint server](https://arxiv.org/)

- [NED (NASA/IPAC Extragalactic Database)](https://ned.ipac.caltech.edu/) (with links to images and catalogs, such as RC3, ESO, UGC)
  - [Notes](https://ned.ipac.caltech.edu/) on how to convert coded revised Hubble types in RC3
  - [Original table from RC2](https://ned.ipac.caltech.edu/) on how to convert coded revised Hubble types in RC3

- [Atlas of Peculiar Galaxies](https://ned.ipac.caltech.edu/) (Halton Arp, 1966; Images and data on 338 peculiar galaxies).

- [References for Handbooks of Mathematical Functions](https://www.as.utexas.edu/~sj/a386c-fa22/)