In-Depth Review of GE Requirements

Physics Department

January 12, 2024

1 PHY 122A: Advanced Lab in Physics – Writing Experience

This summary refers to the minimal elements of the Writing Experience[1]. The material submitted for this in-depth review was prepared by Prof. Matthew Citron[2] from a class he taught in Spring 2023. PHY 122B (Particle Physics) and PHY 122A (Condensed Matter Physics) are team taught, simultaneously, which is why the included course material refers to only PHY 122. All supporting documentation is available in Appendix A.

(ME1) Demonstrate that writing is a central component of the course: Students conduct two elective experiments during the course and prepare a written lab report for each one.

(ME2) Show that students are trained in the writing conventions of the relevant discipline: See "Preparting a Report on Your Experiment" which includes an overview, links to a 25 slide talk, APS style instructions, and example texts.

(ME3) Assure that model texts are provided and discussed: Four example scientific articles are provided on the course website. These are referred to for concrete examples when discussing the writing conventions and other issues that arise.

(ME4) Demonstrate that the 5/10 page (1500/3000 words) writing assignment(s) requirement is met. Revisions are encouraged, but revisions of past submissions do not count toward the 10-page minimum: Students prepare two reports, each typically 8-16 pages, and always more than 10 pages total. The course includes revisions, but those have not been counted here.

(ME5) Provide specific demonstration and explanation of the evaluation criteria: The rubric used to grade the reports is included in the section on preparing reports.

ME6) Demonstrate that individual feedback from instructors or teaching assistants is integrated into the course in a manner designed to promote improvement in writing: As explained in the course overview, students are given feedback on their first report, which they revise and submit for a final grade.

(ME7) Show that guidance on plagiarism is provided: Plagiarism results in an F for the course. Three useful resources are provide to explain plagiarism.

(ME8) Demonstrate that the learning objectives of the literacy are an integral part of the class: The lab report is the graded deliverable for each of the two elective experiments conducted by each student during the course. Students are encouraged to begin drafting their report as soon as they have developed a written plan.

[1] https://ge.ucdavis.edu/sites/g/files/dgvnsk4376/files/inline-files/final_writing_experience_8.20.20.pdf (click)
[2] Citron is nominally assigned to PHY 122B, but the course is team taught.

2 AST 10G: Intro to Stars, Galaxies, and the Universe – Visual Literacy

This summary refers to the minimal elements of Visual Literacy[3]. The material submitted for this in-depth review was prepared by Prof. Andrew Wetzel from a class he taught in Fall 2023. All supporting documentation is available in Appendix B.

(ME1) Identify the type of visual materials or media employed in the class. These may include still and moving images, art and architecture, illustration accompanying written text, graphs and charts, or other visual embodiments of ideas: From the syllabus: "scientific images, movies, figures, charts, and tables".

(ME2) Specify how the course enables students to think critically about visual materials: An example is provided in the course overview: "for example, we will ask you to interpret images and spectra from astronomical objects, including what these can tell us physically about these objects." Scientific interpretation of the provided images requires critical thinking.

(ME3) Specify the ways in which students will use or interact with these materials throughout the course and how frequently they will be used in lectures, student work and/or examination and assessment: The example from ME2 applies here, but also from the the course overview: "You also will develop skills to interpret x-y type plots, charts, and tables of astronomical data. We will employ such visual analysis in every class. . . "

(ME4) Identify specific guidelines or metrics for evaluating the students' understanding of visual literacy (e.g. through examination, written analysis, production of visual materials, and so on): The provided example of student work from an examination has students prepare their own visual media (a Hertzsprung-Russel diagram in this case). The points assigned to each part are indicated. The examples from ME2 and M5 also apply here.

(ME5) Demonstrate that achieving the minimum set of learning objectives of the literacy is an integral part of the class: From the course overview: "we will evaluate your understanding through weekly reading quizzes, weekly problem sets, and 3 exams, which will include both intepreting visual data and communicating your answers through visual means."

[3] https://ge.ucdavis.edu/sites/g/files/dgvnsk4376/files/inline-files/final_visual_literacy_0.pdf (click)

3 AST 10C: Intro to Cosmology – Scientific Literacy

This summary refers to the minimal elements of the Scientific Literacy [4]. The material submitted for this in-depth review was prepared by Prof. Lori Lubin from a class she taught in Spring 2023. All supporting documentation is available in Appendix B.

(ME1) Demonstrate that a substantial portion of the course covers scientific methods: posing questions, gathering data, making conclusions and generating new hypothesis when appropriate: From the course description: "You will learn all the clever ways that astrophysicists have come to understand the cosmos so well (despite sitting on some small rock!) – all the way from posing the relevant scientific questions, determining what observational data to collect, interpreting that data, and finally to developing theories (Hint: It is not "just" a theory!)."

(ME2) Demonstrate that the course covers how scientific findings relate to other disciplines and public policy: From the course description "Finally, science does not progress in a vacuum, so you will learn how cosmology research over the past century was crucially aided by, and contributed to, significant technology and engineering gains (just look at the new James Webb Space Telescope!)."

(ME3) Provide specific demonstration and explanation of the evaluation criteria referring to the scientific literacy: The provided example assignment has students interpreting scientific results, and then applying scientific methods. The grading rubric (and its application to example student work) is shown.

(ME4) Demonstrate the achieving the minimum set of learning objectives of the literacy is an integral part of the class: The overall importance of ME1 and ME2 is stressed in the course overview. The provided example of student work provides further evidence, in that students are expected to master ME1.

[4] https://ge.ucdavis.edu/sites/g/files/dgvnsk4376/files/inline-files/final_scientific_10.25.19.pdf (click)

A Supporting Material: PHY 122A

This section includes the supporting material for PHY 122A. It may be more convenient to peruse the course website:

https://122.physics.ucdavis.edu (click)

Actual student work is not included in this appendix and will be provided separately. (Even though it is redacted, we prefer to keep it separate from this report, which is public.)

Syllabus

Melissinos Exercises (2nd Edition)

Course Goals

1. Learn how to perform scientific experiments.
2. Learn how to perform data analysis and presentation.
3. Learn how to write a scientific report.

Professors

Shirley Chiang, 235 Physics Building, chiang@physics.ucdavis.edu
Matthew Citron, 315 Physics Buildling, mcitron@ucdavis.edu

Teaching Assistants

Morgan Walker, 75 Physics, mawwalker@ucdavis.edu
Daniel Polin, 512 Physics Building, dapolin@ucdavis.edu

Meeting Schedule

Mondays and Wednesdays 2:10 PM - 6 PM, 156 & 154 Roessler

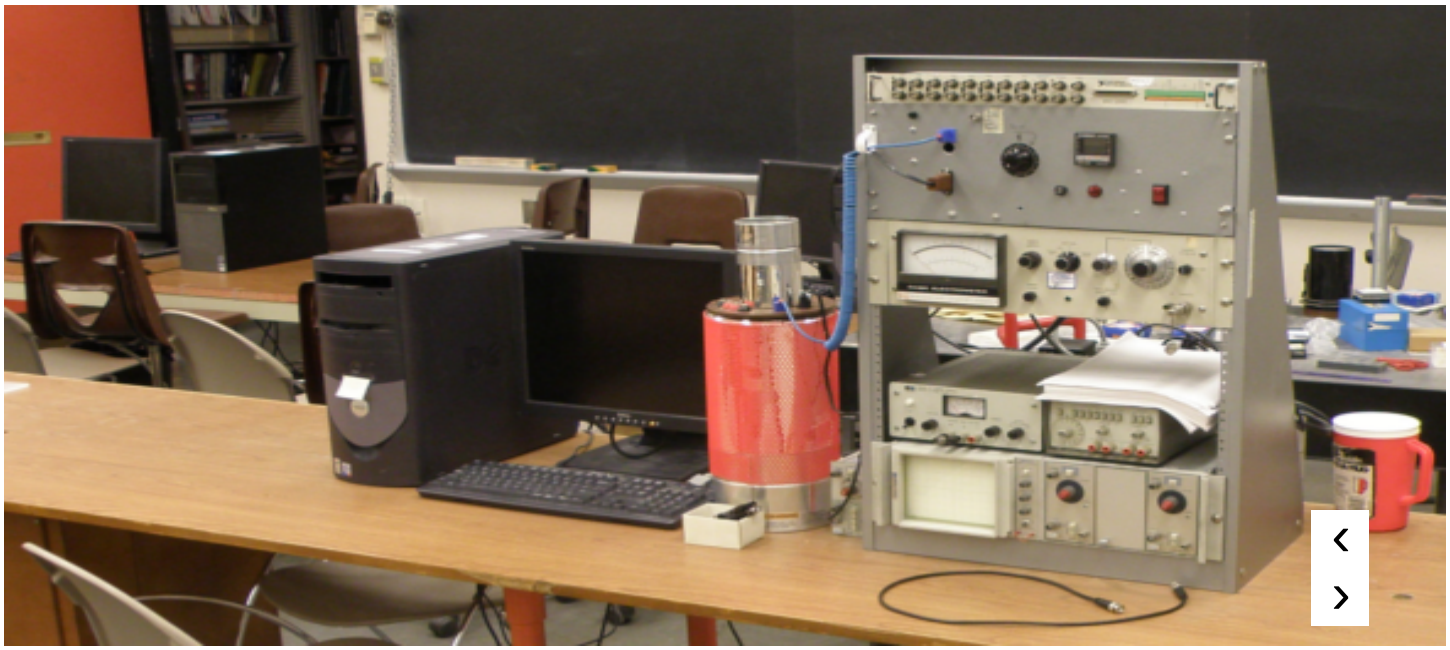
Experiment Guides

Go to the Experiments section.

Grading Policy: see details in the Canvas site

UNETHICAL CONDUCT: Plagiarism results in an F grade in the course.
Helpful links:
https://great.ucdavis.edu/student-life/plagiarism
https://www.ox.ac.uk/students/academic/guidance/skills/plagiarism?wssl=1
https://integrity.mit.edu/handbook/what-plagiarism

NO LATE REPORTS WILL BE COLLECTED



Physics 122

Please use Canvas for the updated information including Syllabus. The aim of this course is to introduce you to the techniques of experimental physics. In this course you will learn how things work (electronics, detectors, and some optics), how to make measurements, solve problems encountered in experiments, how to analyze data, identify sources and nature of error and estimate their numerical significance on key findings of your experiments, and write up scientific articles on your experimental results. Like in real life experiments, you will need to find your way through unknowns and failures, these are not cook book type experiments. You will completely "own" your experiment, from design to construction to analysis to publication. Scientific writing is emphasized.

You will work in groups. However you will troubleshoot, record/analyze experimental set ups and data, and write lab reports by yourself. It is very important that you read the assigned and suggested reading BEFORE class. Full Pre-Lab reports are due on the first day of a lab. See the Canvas/Syllabus tab for up-to-date deadlines. You will not have time to come up to speed during lab class. Your first week is critical. You should gain sufficient working knowledge of data analysis, error estimation and least squares fitting methods so that you come into your nuclear decay experiment prepared. Specific pages of the text, Melissinos *Experiments in Modern Physics.* are uploaded but we suggest you get a copy; You will find the superb text by Barlow, *Statistics, A Guide to the Use of Statistical Methods in the Physical Sciences* a must reference.

A lab book with large gridded and numbered pages: similar to the Ampad #22-157, 9-1/4" x 11-3/4" is required. It is sometimes available in the campus bookstore [#074319221579], or better Amazon. Bring this to the first class.

We have created this website which describes the mandatory and elective labs for this class. PHY122A and PHY122B are the same course, same class. You are encouraged to explore the various pages for each experiment before the first class. Read the overview, experiment guides,

related material etc, but do not expect the guides to be step by step, cook book manuals.

CRN: Students should inform Amy Folz (aefolz@ucdavis.edu) in the Physics Office if they will require Phy 122 in the Winter Quarter or the Spring Quarter 2024. PTA's cannot be assigned without providing this information before Pass 1. The prerequisites will be strictly adhered to.

In the **first week** you will:

1. Sign up for two **elective experiments** (1st, 2nd, 3rd, 4th choices) using the form.
2. Review the lab on Data Analysis.
3. Start your required experiment, Nuclear Decay.
4. Read On Being a Scientist: *Responsible Conduct in Research.*

Be sure to complete assigned reading in advance of class.
Pre-Lab assignments must be handed in at the start of Lab.

Please find quarter-specific information in the Canvas course site.

Meeting Schedule
T R 2:10 PM - 6 PM.

Prerequisites
Physics 80, 104A, 105A, 110A, 110B, 115A, and 112. This course satisfies 4 units of the GE writing requirement.

Grading
Your letter grade will be based on a combination of "points" and your in-lab performance. The counting statistics experiment is worth **10 points**, Quiz is **7 points**, Pre-labs are worth **8 points**, Lab book is **5 points**, and each of the two elective experiments is worth **35 points.** You will write two reports, one for each experiment. The first report will be graded twice, once for feedback on your writing and again once for your actual grade. Pre-Labs form an important component of your experiment grades, and are due at the beginning of class on the first day of starting a new experiment. No credit will be given for late Pre-Labs. Letter grade will also be based class performance including on-time submission of experiment Plans and draft report sections, teamwork, lab books, and demonstrated ability to problem-solve. You will not be penalized for not getting the correct answer, rather your grade will depend on how systematically you approach the tasks and solve the inevitable problems. Note that the goal of this course is not to teach you the right answer but to instruct you how you can figure out the answers. We are here to help and to guide you in this process. We will teach you problem-solving strategies, for instance, by asking questions rather than giving you the answer you might actually seek.

Notebooks and Reports

LAB NOTEBOOKS

(These will be checked regularly and will form part of your grade)

You are required to have a lab notebook with numbered pages and to have your experiment details written in it. *Be neat and spread out.* Allocate at least 20 pages per experiment. Write the following (in pen only) in your lab notebook:

1. Description of your experiment.
2. Relevant apparatus details.
3. Your data or where it is stored. Examples of your signal.
4. The procedures that you use to obtain the data.
5. The data analysis including the necessary theory and equations directly relevant to the analysis.
6. Detailed error analysis including investigations of systematic errors.

For data acquired by a computer, you may paste or staple the tables or plots of data into the notebook. The objective is to have **all** of the important information written down so that you or someone else can reproduce the experiment and find the essential parameters.

This information will be your primary source for both data and troubleshooting. For this reason it is important that you record as much as possible and erase nothing, use a pen. Too much information is better than too little as you never know where discoveries lay hidden. NEVER tear out a page. Homework in this course is handed in separately. One more reason why you might want to keep a notebook.

PREPARING A REPORT ON YOUR EXPERIMENT

Your laboratory report should be as professional as possible. Style examples are linked on the right. Your report must be your own work, including your own analysis [we will check]. It should be sufficiently explanatory and neat that a colleague of yours, new to this course, should be able to understand your experiment and carry it out based on your report. Do not write your report in lab book or cook book style ("I did this, then I did that"). Rather outline the physics question, the experiment design, your procedure, analysis, results and conclusions. In particular, your report should contain the following sections in addition to a brief, descriptive title, and your name and institution. *You are required to use Latex; please use the Latex template linked on the right side.* Begin drafting your report as soon as you develop a Plan, but no later than one week after starting the experiment. Your letter grade in the course will reflect how proactive you are. UNETHICAL CONDUCT: PLAGIARISM IS AUTOMATICALLY DETECTED AND WILL BE REPORTED TO THE J-BOARD.

REPORT SCORE BREAKDOWN

- (5 points) **Abstract**: A brief summary of the experiment and the key results obtained, including statistical and systematic error estimates.

- (20 points) **Introduction**: States the motivation for doing the work and spells out the goal of the work to be performed. Also describes in some detail the theoretical background behind the experiment.

- (20 points) **Experimental setup and procedure**: Clearly states why the methods used are adequate for the proposed goal of the experiment, sufficient for another student to understand what you have done.

- (35 points, 15 points designated to error analysis) **Results and Analysis**: Displays the processed data that are essential to the goal of the experiment. States briefly how the original data are processed and analyzed before display. Most importantly, makes a comparison of the processed data with the theoretical expectations as outlined in the introduction. Be sure to include error analysis of the data and show error bars on graphs. Don't display the unprocessed raw data--those should be in your lab notebook. All graphs need axes, tick marks, units and fully descriptive captions. See below for available software.

- (15 points) **Discussion**: Answer the question: From the results obtained, have you achieved the goal set in the introduction? Explain. Do the results support the understanding of the subject within experimental uncertainties? Again, explain. Suggest possible improved experiments which could result in greater precision.

- (5 points) **Conclusion.** Restate your findings, commenting on key points raised in the discussion.

- **References**: Published journal articles, books, etc. relevant to this experiment, including experimental techniques, electronics, data analysis and statistics. ***Wikipedia is not an acceptable reference.***

Style

Check out Writing Physics Papers for additional information and an example of acceptable report style. Reference all figures in the text, sequentially. Figures with fully descriptive captions may be inserted in the text or placed at the end. It is far better to put them in the text where they are referenced. Mimicking the writing style of the examples in the right hand column may result in a higher grade. The APS style instructions can be found here.

Curve Fitting and Plotting

Software packages are available on the computers in the 122 lab: KaleidaGraph (overly simple analysis, curve fitting) and Igor (more sophisticated analysis and curve fiting with publication quality plots and graphics). You are encouraged to use Python! Python has become the dominant software in science and engineering. Online information regarding data analysis software can be found at the following:

Getting Started with Python
Scientific Computing with Python Tutorial
Jupyter Notebook information

KaleidaGraph Manual
KaleidaGraph Notes
KaleidaGraph Statistics and Fitting
KaleidaGraph Tutorial

Igor Manual section on Fitting
The downside of Igor

B Supporting Material: AST 10G

This section includes the supporting material for AST 10G.

Actual student work is not included in this appendix and will be provided separately. (Even though it is redacted, we prefer to keep it separate from this report, which is public.) This student work includes the assignment and rubric.

AST 010G 001 FQ 2023

Jump to Today ✎ Edit

Astronomy 10G
Introduction to Astronomy
2023 Fall

Classes
Roessler 66
Tue, Thu 3:10 - 4:30 pm

Recitation section
Physics 416
Mon 11 am - 12 pm

Instructor
Prof. Andrew Wetzel
Contact: please use Canvas mail (NOT email), I generally will respond between 9 am - 5 pm. Please direct all questions via Canvas mail about the problems in the reading quizzes and problem sets to the TA.
Office: Physics 533
Office hours: Wed 2 - 3:30 pm (may be in Physics 525 if many students)

TA
Kelsey Glazer
Contact: please use Canvas mail (NOT email). Please direct all questions via Canvas mail about the problems in the reading quizzes and problem sets to the TA.
Office: Physics 531
Office hours: Wed 12 - 2 pm in Physics 416
Recitation section: Mon 11 am - 12 pm in Physics 416

Overview

This course is a *quantitative* introduction to astronomy. We will cover the history, content, and fate of the universe. Turns out, the universe is *big*, and one quarter is not nearly enough time to cover everything. So, we will cover some of the cool stuff and provide you with the background to understand some of the crazy stuff that you read about in the news: black holes, exploding stars, the birth of galaxies, the expansion of the Universe. The first third of the class will cover scientific methods, the forces of nature, matter, and energy, to provide the needed background. The second third will focus on the Sun, stars, their life cycles, black holes, and General Relativity. Finally, we will learn about the Milky Way, other galaxies, and the observable history of the universe, including the expansion and the Big Bang.

This course will involve math and quantitative analysis. This is an essential aspect of science.

Come, have fun, and be awed by the wonders of the Universe. The sky is **not** the limit, it is just the beginning!

Key learning goals

One integral part of this course is for you to develop proficiency in visual analysis of scientific images, movies, figures, charts, and tables, including understanding ideas presented visually and the ability to communicate knowledge by visual means. For example, we will ask you to interpret images and spectra from astronomical objects, including what these can tell us physically about these objects. You also will develop skills to interpret x-y type plots, charts, and tables of astronomical data. We will employ such visual analysis in every class, and we will evaluate your understanding through weekly reading quizzes, weekly problem sets, and 3 exams, which will include both interpreting visual data and communicating your answers through visual means.

Another key goal of this course is for you to be able to use the scientific method to approach problems, pose questions, analyze data, and make conclusions. We will devote an entire class to discussing the meaning and philosophy behind the scientific method, and we will use it continuously throughout the course to understand astrophysical phenomena. Many of the questions that you will answer throughout the course will involve quantitatively analyzing astronomical data. We also will aim to relate your understanding of astronomy to other disciplines, including physics, chemistry, biology, history, and public policy.

Learning philosophy and effective learning

Science is not a set of information - *it is a way of thinking*.

Studies on the efficacy of learning consistently demonstrate that *active* learning, in which *you* take a driver's seat to your learning, is more effective than (just) one-way lecture format. In fact, research has shown that everything that makes learning *feel* easy, in fact, contributes to making it less effective! This means that you have to struggle with the material at some level to achieve deep learning.

While this requires a bit more work from you, the effectiveness of your learning will be substantially higher - you will learn more and remember it better if you engage in active learning.

This **NY Times article** (https://www.nytimes.com/2023/04/20/opinion/studying-learning-students-teachers-school.html) nicely discusses empirical evidence for ways to study more effectively.

I **highly** recommend this **series of videos** (https://www.youtube.com/playlist?app=desktop&list=PL0lAafWhXlEAqiSfmx8TKF9JuBS6swFac) by Steve Chew on effective studying.

Perhaps the most important step in active learning is for you to adopt a **growth mindset.** (https://fs.blog/carol-dweck-mindset)

UC Davis offers useful tips for effective **active learning** (https://cee.ucdavis.edu/sites/g/files/dgvnsk5371/files/media/documents/Active_Learning_Part_9_JITT.pdf) .

Textbook

The Cosmic Perspective: Stars, Galaxies, and Cosmology, 10th edition, published in 2023
Bennett, Donahue, Schneider, Voit
http://www.mypearsonstore.com/bookstore/cosmic-perspective-stars-and-galaxies-0134990781 (https://www.pearson.com/en-us/subject-catalog/p/cosmic-perspective-the/P200000009792/9780138185251)

Expert TA online platform

We use the Expert TA online platform. **theexpertta.com** (http://theexpertta.com) , for all reading quizzes and problem sets. You first must register using this link:

http://goeta.link/USB06CA-616221-328 (http://goeta.link/USB06CA-616221-328)

Enter your email, first name, last name, and then you can redeem your Equitable Access code. (I strongly recommend that you enroll in the Equitable Access program, but if you choose not to, you can pay via credit card, bookstore access code, or enroll in a 14-day free trial.)

Then, you will log into **theexpertta.com** (http://theexpertta.com) to see and complete all of your assignments. We aim to release/publish these by the Friday before they are due. You can work on and submit your answers any time before they are due.

For most questions, you have 2-3 attempts to get the answer correct, though with reduced credit for each resubmission. Some questions allow you to request a 'hint' before answering for a small score penalty. If you do not get the answer correct, some questions then allow to you request 'feedback' on your incorrect answer, again for a small score penalty. For many questions, however, there are no hints or feedback.

Expert TA has its own online astronomy 'textbook', which is a useful supplementary resource, and I encourage you to read at it as well. But all of the assigned reading for this course will be from our main textbook, the Cosmic Perspective.

Direct all Canvas mail questions about the problems in the reading quizzes and problem sets to the TA.

Grading

10% weekly reading quizzes (online)
20% weekly problem sets (online)
20% midterm 1 (in class)
20% midterm 2 (in class)
30% final exam (in class)

We will drop your single lowest-scored quiz and your single lowest-scored problem set when calculating your final grade. So if you have an emergency in any given week, it will not hurt your final grade.

The final grade that you **earn** in this course will be based on an adaptive ('curved') grading scale. *This is generally to your benefit, because it ensures an equitable final grade distribution, even if my exam questions end up being extra difficult this quarter.* As such, we do not assign a grade to an individual problem set or exam, we only score them as a percentile and compute your final percentile (to compute your final grade) using the weighting above.

To give you some sense of a typical grade distribution, here are the final grade cutoffs from the previous time I taught this course. However, **these are not necessarily the actual cutoff scores for this course: we will compute them based on everyone's final score distribution.**
A- : roughly 87%
B- : roughly 77%
C- : roughly 67%
D- : roughly 57%

Reading quizzes

In order to get the most out of class, you should read the chapters **beforehand**, so you are familiar with the material that we will cover in class. *Expect to spend 2 - 3 hours per week reading the textbook.*

We will have weekly reading quizzes (online via **Expert TA** (http://theexpertta.com)) to encourage you to read the textbook before class, think about the material, and give you credit for doing so. These quizzes are just a few simple conceptual questions that should be straightforward to answer if you read the textbook. They are due **every Tuesday by 1 pm, and we will not accept any late submissions**. Do not wait until the last minute, in case you encounter technical issues. These questions will be similar to (and in some cases identical to) exam questions, so they provide an good way to prepare for the exams. In addition, your scores will help me to tailor each class to the topics that you found most confusing.

Problem sets (homework)

We will have weekly problem sets (online via **Expert TA** (http://theexpertta.com)) to help you digest the course material. They are due **every Friday by 1 pm (except weeks when we have a midterm exam), and we will not accept any late submissions.** Do not wait until the last minute to submit, in case you encounter technical issues. The midterm and final exams will be based on problems similar (and in some cases identical) to those in the problem sets. Therefore, it is *imperative* that you keep up with the problem sets, which gives both you and me feedback about how well you understand the course material before the exams.

We *strongly* encourage you to attend office hours to work on your problem sets and ask us questions. *This is the best way to ask us questions about the problems.* If you are unable to attend office hours, you are welcome to send questions via Canvas mail, please direct those to the TA.

Exams

We will have three in-class exams to evaluate your understanding of the course material. The topics for these questions will come from the textbook and class discussion. The exams will be multiple choice plus short answer, will cover specific chapters, and will be cumulative in the sense that most lectures build on materials from the previous lectures. **We will not offer any make-up exams, except for documented emergencies (with written proof, such as a doctor's note).**

For each exam, we will choose at least one question each from (1) a problem set, (2) a reading quiz, and (3) in-class questions. Thus, your coming to class, thinking through the questions, completing the problem sets and online quizzes, are excellent ways to prepare for the exams.

The exam dates are

Midterm 1: Oct 19 (Thursday) at 3:10 - 4:30 pm in class
Midterm 2: Nov 16 (Thursday) at 3:10 - 4:30 pm in class
Final exam: Dec 13 (Wednesday) at 8 - 10 am in class

Late enrollment

If you enrolled late, be sure to read the chapters of the textbook and review the slides from the classes that you missed. *We do not allow for 'make-up' work for any reading quizzes or problem sets that you missed.* As described above, we drop your lowest-scored reading quiz and lowest-scored problem set in computing your final grade, so if you missed those in the first full week, it should not affect your final grade.

Slides from class

I will post a PDF of our slides from each class. You can access them via the 'Files' link at the left, under the 'class slides' folder. I do this primarily to help you review what we covered in class, and to help those of you who have to miss class for sickness, etc. *However, I implore you to attend and participate in class in person throughout the quarter and not just use these slides as a substitute for that!* We will have much more in our classes than just these slides, including movies, interactive demonstrations, and interactive questions.

Academic conduct

This course will abide by the UC Davis **Code of Academic Conduct** (http://sja.ucdavis.edu/files/cac.pdf) . You are **required** to acknowledge your responsibilities regarding the Code of Academic Conduct for each registered course at **participate.ucdavis.edu** (http://participate.ucdavis.edu) , reinforcing our campus culture of honesty. You also should familiarize yourself with the **Student Responsibility and Conduct Standards** (http://sja.ucdavis.edu/scs.html) in general.

We will report any evidence of cheating on problem sets, exams, or quizzes to Student Judicial Affairs. Students who violate the Code of Academic Conduct are subject to disciplinary sanctions that include: censure, probation, suspension, deferred separation, or dismissal from the University of California. Please do not jeopardize your college career over a few points!

Three common and reportable violations that you need to avoid:

1) Plagiarism
You are not permitted to copy word-for-word text from another source (like your textbook). You either need to paraphrase or cite the source. See **here** (http://sja.ucdavis.edu/faq.html#20) for the definition of plagiarism and how to get help with learning about how to cite sources properly.

2) Misuse of an instructor's course materials or the materials of others
You are not permitted to use previous class solution sets or any other existing solutions to the exams, quizzes, or problem sets. See the description of misconduct **here** (http://sja.ucdavis.edu/files/cac.pdf) .

3) Unauthorized distribution of course materials or recording of lectures
You may not make audio or visual recordings of lectures or class presentations without my advanced written consent. Recording of lectures or class presentations made with my advanced consent is authorized solely for the purposes of individual or group study with students enrolled in the same class unless given explicit written consent for other uses. The recording may not be reproduced or distributed in any manner, including the Internet, without my written consent.

You may work on your problem sets together, but you individually must submit your own version. I encourage you to work collaboratively. **However, this is fundamentally different than copying**. If we detect copying, we will report it to Student Judicial Affairs.

The TA and I will hold weekly office hours, to help you out with any questions that you may have on either the problem sets or the material covered in class.

Observing lab (fall quarter and spring quarter)

If you want to spend one night per week looking at the sky through telescopes, to see many of the objects that we talk about in class, while having a lot of fun, I encourage you to sign up for the *optional* 1-unit Astronomy 10L, offered in fall and spring quarters.

Course Summary:

Date	Details	Due
Tue Oct 3, 2023	reading + quiz 1 (https://canvas.ucdavis.edu/courses/827706/assignments/1120126)	due by 1pm
Thu Oct 5, 2023	problem set 1 (https://canvas.ucdavis.edu/courses/827706/assignments/1120125)	due by 1pm
Tue Oct 10, 2023	reading + quiz 2 (https://canvas.ucdavis.edu/courses/827706/assignments/1121186)	due by 1pm
Fri Oct 13, 2023	problem set 2 (https://canvas.ucdavis.edu/courses/827706/assignments/1121188)	due by 1pm
Tue Oct 17, 2023	reading + quiz 3 (https://canvas.ucdavis.edu/courses/827706/assignments/1121189)	due by 1pm
Thu Oct 19, 2023	midterm exam 1 (https://canvas.ucdavis.edu/courses/827706/assignments/1120122)	due by 4:30pm
Tue Oct 24, 2023	reading + quiz 4 (https://canvas.ucdavis.edu/courses/827706/assignments/1141522)	due by 1pm
Fri Oct 27, 2023	problem set 3 (https://canvas.ucdavis.edu/courses/827706/assignments/1141549)	due by 1pm
Tue Oct 31, 2023	reading + quiz 5 (https://canvas.ucdavis.edu/courses/827706/assignments/1141536)	due by 1pm
Fri Nov 3, 2023	problem set 4 (https://canvas.ucdavis.edu/courses/827706/assignments/1141550)	due by 1pm

Date	Details	Due
Tue Nov 7, 2023	reading + quiz 6 (https://canvas.ucdavis.edu/courses/827706/assignments/1141538)	due by 1pm
Fri Nov 10, 2023	problem set 5 (https://canvas.ucdavis.edu/courses/827706/assignments/1141551)	due by 1pm
Tue Nov 14, 2023	reading + quiz 7 (https://canvas.ucdavis.edu/courses/827706/assignments/1141540)	due by 1pm
Thu Nov 16, 2023	midterm exam 2 (https://canvas.ucdavis.edu/courses/827706/assignments/1120123)	due by 4:30pm
Tue Nov 21, 2023	reading + quiz 8 (https://canvas.ucdavis.edu/courses/827706/assignments/1141541)	due by 1pm
Tue Nov 28, 2023	reading + quiz 9 (https://canvas.ucdavis.edu/courses/827706/assignments/1141544)	due by 1pm
Fri Dec 1, 2023	problem set 6 (https://canvas.ucdavis.edu/courses/827706/assignments/1141552)	due by 1pm
Tue Dec 5, 2023	reading + quiz 10 (https://canvas.ucdavis.edu/courses/827706/assignments/1141546)	due by 1pm
Fri Dec 8, 2023	problem set 7 (https://canvas.ucdavis.edu/courses/827706/assignments/1141553)	due by 1pm
Wed Dec 13, 2023	final exam (https://canvas.ucdavis.edu/courses/827706/assignments/1120124)	due by 10am

C Supporting Material: AST 10C

This section includes the supporting material for AST 10C.

Actual student work is not included in this appendix and will be provided separately. (Even though it is redacted, we prefer to keep it separate from this report, which is public.) This student work includes the assignment and rubric.

AST 10C : Introduction to Cosmology
Spring 2023

To jump straight to the syllabus, click here
To jump straight to textbook information, click here
To jump straight to the grading policy, click here
To jump straight to the homework, click here

Instructor: Professor Lori Lubin
Email: Contact through Canvas mail tool or Piazza
Website: See course website at canvas.ucdavis.edu
Lectures: TR 3:10 - 4:30 PM, RESSLR 66
Office Hours: W 11-12 PM, PHYSIC 432

Teaching Assistant : Karthik Prabhu
Email: Contact through Canvas mail tool or Piazza (preferred) or kprabhu@ucdavis.edu
Office Hours : T 11-1 PM & R 9:45-11:45 AM, PHYSIC 432

Course Description:

This class will be an introduction to cosmology. In it, we will cover the history, content, and fate of the universe. Unfortunately, the universe is really, really big, and ten weeks is not nearly enough time to cover everything! Instead, we're going to try to cover some of the really cool stuff and provide you with the background to understand some of the crazy things that you have read about in the news -- the birth of galaxies, the expansion of the universe, the nature of dark matter and dark energy, and the big bang.

In this class, you will learn all the clever ways that astrophysicists have come to understand the cosmos so well (despite sitting on some small rock!) -- all the way from posing the relevant scientific questions, determining what observational data to collect, interpreting that data, and finally to developing theories (Hint: It is not "just" a theory!). You will try your own hand at interpreting astronomical images (not just pretty pictures!) and graphs (is that a correlation?) to see how astrophysicists use these critical visual tools to understand our Universe. Finally, science does not progress in a vacuum, so you will learn how cosmology research over the past century was crucially aided by, and contributed to, significant technology and engineering gains (just look at the new James Webb Space Telescope!).

In order to get the most out of class, you should read the textbook chapters before hand so that you are familiar with the material that I will be covering. In addition, I will be using well-tested and effective educational technology in your class. There will be weekly online quizzes and

homework given through the the Expert TA, an indepedent online homework and tutorial system. In addition, each student will use the iClicker Student Mobile App on your mobile device to participate (with me) in the lectures. So come, have fun, and be awed by the wonders of the universe.

e-Textbook:
(Required) Stars, Galaxies & Cosmology
The Cosmic Perspective (Volume 2), Ninth Edition
Bennett, Donahue, Schneider, and Voit
Addison-Wesley, 2020

(Recommended) Openstax Astronomy, a free astronomy textbook available at https://openstax.org/details/books/astronomy or through the Expert TA.

Additional information, websites, and tutorials are available on the course website at canvas.ucdavis.edu (under "Pages")

Grading:
20% First Midterm
20% Second Midterm
20% Final Exam
30% Homework
10% Online Quizzes
3% Extra Credit (In-class iClicker and Piazza Participation)

Your lowest quiz and homework grade will be dropped when calculating your final grade.

Code of Academic Conduct:
Any evidence of cheating on quizzes, homeworks, or exams will be reported to Student Judicial Affairs. This includes the use of any "answer sharing website" (such as Chegg) to search for the solutions to your problems. You should review carefully my instructions concerning the Code of Academic Conduct on the course website at Know the Code of Academic Conduct (under "Pages") and be very familiar with the Student Responsibility and Conduct Standards in general.

My lectures and course materials, including PowerPoint presentations, lecture recordings, videos, exams, handouts, and similar materials, are protected by U.S. copyright law and by University policy. I am the exclusive owner of the copyright in those materials. You may take notes and make copies of course materials for your own use. You may also share those materials with another student who is enrolled in or auditing this course. You may not reproduce, distribute or display (post/upload) lecture notes or recordings or course materials in any other way - whether or not a fee is charged - without my express prior written consent. You also may not allow others to do so. If you violate these terms, you will be subject to student conduct proceedings under the

UC Davis Code of Academic Conduct.

Students are required to acknowledge their responsibilities regarding the Code of Academic Conduct for each registered course at participate.ucdavis.edu, reinforcing our campus culture of honesty. Remember that students who violate the Code of Academic Conduct are subject to disciplinary sanctions that include Censure, Probation, Suspension, Deferred Separation or Dismissal from the University of California.

Course Discussion Board (Piazza) and Email Protocals:
This quarter, we will be conducting all out-of-class related discussions and Q&A through Piazza available through the course navigation toolbar in Canvas or directly at https://piazza.com/ucdavis/spring2023/ast010c001sq2023/home.

Piazza is a way for you to interact with your fellow students, exchange ideas, ask questions (anonymously if you wish), and get help from me, your TA, and your fellow students with the course material. Rather than private emails to me and your TA (as we may be slow), try posting your questions first on the Piazza discussion board. Other students likely have the same questions and/or know the answers!

Before starting, you should review the rules governing the use of the Piazza discussion board on the Canvas course site at Rules of Course Discussion Board Piazza (under "Pages"). Students who participate in the Piazza discussion board can earn extra credit points.

Note that your TA and I will do our best to answer your private emails as soon as possible, with the goal of answering within 48 hours.

In-class iClicker Participation:
I plan to use the iClicker Cloud system, which allows for electronic polling of the student audience through the iClicker Student Mobile App available on mobile devices. Note that as of Fall 2020, the UC Davis Bookstore acquired a campus-wide license for all students to use the iClicker Student Mobile App at no cost. So come to class and try out this freebie with me! During lectures, I will periodically ask questions which can be answered using the iClicker app on your mobile device. Your answers will be recorded, tallied, and displayed by the computer. All in-class responses will be displayed anonymously, so click without fear! Right answers are not necessary! You will earn extra credit just for participating.

If you have not already downloaded the app, you can get information on the mobile app and download it through the iClicker webpage at iClicker Student App. You will also need to have an iClicker Student Acccount, which should be set up using your offical UC Davis (kerberos) email address. To see a demonstration video, go to Create an iClicker Student Account. I have setup a Roster & Grade Sync (RGS) iClicker integraton with our Canvas site. If you have an existing iClicker student account that uses an official university email address and/or Student ID, you will

automatically get added to the iClicker course. For more information on finding the course on your app, see Student Guide: iClicker Roster & Grade Sync Integration. All this information, as well as the benefits of students teaching each other ("peer instruction"), is also available on the course website at canvas.ucdavis.edu (under "Pages").

Online Homework:

There will be weekly homework assignments to help you digest the material, apply the scientific method yourself to specific problems in cosmology, using real and simulated data, and learn how to interpret key astronomical images and diagnostic diagrams. The three exams will be based on similar problems to those covered in the homework assignments. It is extremely important to do the homework assignments; it gives both of us feedback about how well you understand what's going on before the exams! You should expect to spend 2-3 hours per week reading the textbook chapters and related materials, in addition to the time required for the homework.

All homework must be completed by logging into the Expert TA. The link to the Expert TA is also available through the course navigation toolbar in Canvas. For more information, see Registering and Using the Expert TA (under "Pages") on the Canvas course site.

The homework will be available on the Expert TA every FRIDAY. The homework will be due the following THURSDAY at 3:00 PM before the scheduled class time. Late homework will be penalized by 25% or more so do your homework on time. There will be no homework due during an exam (or holiday) week.

Online Quizzes:

To encourage you to do the **upcoming week's** readings, there will be a short online quiz (only a few multiple choice questions) each week that must also be completed by logging into the Expert TA. The quizzes will be available on SUNDAY and due the following TUESDAY at 3:00 PM before the scheduled class time (unless it is an exam week). The quiz questions will help you solidify the lecture materials.

Exams:

The three exams will test your knowledge, understanding, and comprehension of the course material. The questions will come from the text, lecture notes, and exercises. Exams will be multiple choice plus short answer, will cover specific chapters, and will be cumulative only in the sense that most lectures build on the materials in the previous lectures. All exams will be given IN PERSON in RESSLR 66. There are no make-up exams (except for documented emergencies), so make sure that you are there.

The exam dates are:

Midterm I: Tuesday, 25 April 2023. 3:10-4:30 PM

Midterm II: Tuesday, 23 May 2023. 3:10-4:30 PM

Final Exam: Monday, 12 June 2023. 6:00-8:00 PM

Study guides for each exam will be available on the course website at canvas.ucdavis.edu (under "Files/Exam Study Guides").

Syllabus : Note content is subject to change!

Topic	Description	Associated Reading	Relevant Links
1. Overview	Introduction to the Universe Scale and Appropriate Units Characteristic Sizes, Masses, and Velocities	**Chapter 1**	
2. Light and Matter	Properties of Light The Electromagnetic Spectrum Properties and Phases of Matter Types of Spectra Interaction between Matter and Light Light & Temperature Thermal Radiation The Doppler Effect	**Chapter 4.3 & 5**	The Science of Light
3. Telescopes & Observational Techniques	Design and Characteristics of Telescopes Imaging and Spectroscopy Ground versus Space Based Observatories	**Chapter 6**	See the Big Scopes Where is Webb? US Extremely Large Telescope Program European Extremely Large Telescope
4. The World of	Island of Stars - A Brief Introduction Stellar Orbits	**Chapter 15.1-15.2** **Chapter 19.1**	All about Stars Understanding Spectra of Stars Hipparchos H-R Diagrams Luminosity Primer (PDF)

Galaxies	Star Formation Measuring Luminosities and Distances Galaxy Types	**Chapter 19.2** **Chapter 15.1 & 20.2** **Chapter 20.1**	Look up! Our Milky Way Structure of the Milky Way Our Local Group of Galaxies Galaxies Galore
5. The History of Galaxies	Galaxy Formation Galaxy Mergers, Interactions & Evolution The Role of Supermassive Black Holes	**Chapter 19.3 & 21.1** **Chapter 21.2** **Chapter 18.3, 19.4 & 21.3** **(Optional Chap. S3)**	The Fate of the Milky Way Galaxy Merger Simulations Facts about Black Holes Journey into a Black Hole The Event Horizon Telescope
6. Dark Matter	Gravity & The Orbital Velocity Law Weighing Galaxies Galaxy Clusters and Ways To Measure Their Mass Dark Matter Candidates Large Scale Structure Formation	**Chapter 4.4 & 23.2** **Chapter 23.1-23.2** **(Optional Chap. S3)** **Chapter 23.2** **Chapter 23.3**	Help with Gravity (PDF) Rotation Velocity vs. Mass Images of Galaxy Clusters How to Weigh a Cluster Simulation of a Gravitational Lens
7. The Cosmic Expansion	Measuring Distances (again) Cosmic Distance Ladder The Cosmological Redshift The Hubble Law The Age of the Universe The Curvature of Spacetime	**Chapter 20.2-20.3** **Chapter 22.3**	History of the Expanding Universe Visit the Astronomy Cafe
	Cosmic Microwave		

8. The Early Universe	Background The Big Bang Cooling Universe and the Four Forces of Nature The Formation of Nuclei Cosmic Inflation and Resolving Cosmological Puzzles	**Chapter 22** **Chapter S4.2**	Cosmic Microwave Background Beyond the Big Bang More about the Big Bang
9. The Fate of the Universe	The Curvature of Spacetime (again) Key Cosmological Parameters of the Universe The Existence of Dark Energy Cosmic Acceleration	**Chapter 22.3 & 23.4**	Fire and Ice