ASTRON 1121

Galaxies and Cosmology

Course Information

Prerequisites: Astronomy 113 (Introduction to Astronomy); Math 240 (Calculus 3)
Suggested Corequisites: Physics 479 (Modern Physics I); Math 290 (Differential Equations)

Meeting Time: Monday and Wednesdays, 3 PM – 4:15 PM, Thaw 210

(Note: The 2nd floor of Thaw corresponds to the 5th floor of SRCC or the 3rd floor of OEH.)

Instructor Information

Lecturer: Prof. Jeffrey Newman
Office: 310 Allen Hall
Office Hours: Wednesday 4:15-5:15 PM, Thaw 210; Tuesday 3:30-4:30 PM, office (or by appointment)
Email: janewman@pitt.edu (email is generally the best way to contact me)
Phone: (412) 592-3853

Textbook

Extragalactic Astronomy and Cosmology: An Introduction, by Peter Schneider (second edition)

This book is available in electronic (PDF and Kindle) editions as well as hardcover.

Course Description

This course will be an introduction to the study of galaxies and cosmology at an advanced undergraduate level. These fields have advanced greatly in recent years; we will use state-of-the-art datasets to explore the properties of galaxies and the nature of the expanding

Universe. We will begin by studying our own galaxy, the Milky Way; then move on to the study of galaxies in general, their formation and evolution; and conclude by studying the universe as a whole.

Course Objectives

The primary goals of this course are twofold:

1) to provide a basic knowledge of galaxies and cosmology, providing sufficient grounding to engage in undergraduate research in these fields; and
2) to develop skills in exploring astronomical data and solving problems.

At the end of the course, you should also be able to explain, among other things:

- How the Milky Way Galaxy we live in is similar to (or different from) other galaxies
- Where galaxies come from and how they may transform amongst types
- Why we believe many galaxies have black holes at their center
- What the main constituents of the Universe are
- How the Universe began and what its ultimate fate will be
- How the Universe has grown and changed over time
- How to perform basic calculations, file input/output, and plotting in the Python programming language

Course Structure

In recent years, Physics and Astronomy education research has found in a variety of contexts that the most lasting learning comes not from lectures, but from active engagement with material. The course will employ techniques that have proven effective in the past, in particular group problem-solving. I expect that a significant fraction of class time will be devoted to working together in groups of 3 or so students to solve problems or explore data sets.

Students are expected to have read the relevant sections of the textbook or online readings (listed on Courseweb) before class. Lectures and these activities are a supplement to the textbook, not a replacement. The goal is not for you to understand everything after reading, but you should come to class ready to ask questions about the parts that are unclear!

Grade Weighting

I expect that grades will be weighted as:

30-40%	Homeworks/Projects
25%	Midterm
25%	Final exam
10-20%	Group work / presentations

Homework/projects:
There will be 5-10 homework assignments during the semester, consisting of a variety of astrophysical problems. In some cases, these could be short projects involving the exploration of data.

Exams:

Exams will consist of a variety of problems broadly similar in nature to those on homework assignments or done in class.

Students are allowed (and encouraged) to collaborate in finding solutions to homework assignments, but each student should present their own reasoning and write up their own solution; collaboration on exams is strictly forbidden.

In both homeworks and exams, the focus will be on having the correct reasoning.
No credit will be given for a correct answer without the reasoning being clearly explained. A great deal of the credit for a problem may be given if the reasoning is correct, but the numerical answer is incorrect for one reason or another. Occasionally, you may find an answer that is obviously incorrect. For example, say you derived the distance to the sun to be three miles. In such a situation, you can still get partial credit for the problem simply by recognizing that the answer obviously does not make sense and explaining why the answer is manifestly incorrect.

Group work:
I expect there to be a group project for credit. Some portion of this grade may be credit for participating in groups during class.

Expectations

It will be vital for you to study the material at home, doing reading beforehand so that class time can be used for group work and mini-lectures. I expect you to attend all classes and to come prepared for active participation; failing to do so will not only be sure to impair your performance in the class, but also harm the other members of your group.

Following the Dietrich School of Arts and Sciences' guidelines, I expect that you will study for class and work on class assignments for about 90 hours over the course of the term outside of class meetings (i.e., about 6 hours a week).

I expect you to work in groups to discuss readings and solve problems and to be an active participant in your group. The classroom should be a safe environment for discussing and challenging ideas and concepts. The students and the instructor are expected to treat each other with respect at all times.

I will post new homework assignments on our *CourseWeb* site (at http://courseweb.pitt.edu/); I will not hand them out in class. It is your responsibility to check the site and obtain these materials.

You may discuss homework problems with other students in the course, but you must hand in a unique solution that is your own.

I will accept at most 2 late homeworks from any letter-grade-option student, except in extreme (e.g. medical) circumstances or via prior arrangement more than two days before the deadline. The first late homework will have no penalty, the second one will have a grade penalized by 10%. Late HWs must be turned in within 24 hours of the nominal due date unless otherwise arranged in advance.

Problem solving skills are of utmost importance and you must show all of your work, including all logical and algebraic steps used in deriving your answers in order to earn full credit. You may not refer to algebraic steps performed by a calculator or by a computer software package (Mathematica, Maple, etc.) for derivations. You must perform and show each step yourself.

If a numerical answer is required, you may use a calculator (or write a Python program…) to obtain the relevant number, but you must still show all of the logical and algebraic steps you took to arrive at the answer and the answer must have the correct units in order to receive credit.

Throughout the course, I will give problems where you may need to know a piece of information (for example, the radius of the Sun) that it is not included in the problem statement. I will assume you can look this up in some reputable source (such as our textbook, or a reputable web site), but please indicate your source if you are at all suspicious of your number.

You can expect me to come prepared to give lectures, to explain difficult concepts, to assist your group, to assign relevant readings and homework problems, and to answer any questions you have. I will be a willing listener and advisor in helping you succeed in this class, and with other career questions you might have. You may expect me to be available outside of class to give additional support.

I want this class to be interesting, informative, useful, and fun. I am always open to suggestions and willing to try to modify the topics, etc. to accommodate the interests of the class.

Tentative Calendar

Week begins:	**Planned material**
1/8	Introduction to the Course; Basics of Galaxies and Cosmology (Ch. 1)
1/15	The Milky Way (Ch. 2) **NOTE: NO CLASS ON MONDAY (MLK holiday)**
1/23	The Milky Way; Introduction to Python.
1/30	The Milky Way; Other Galaxies (Ch. 3)
2/5	Galaxies (Ch. 5)
2/12	Exploring galaxy properties
2/19	Exploring galaxy properties; Clusters of Galaxies (Ch. 6)
2/26	Galaxy Evolution; **Midterm exam**
3/5	Spring recess
3/12	Galaxy Evolution; Basic Cosmology (Ch. 4)
3/19	Large-scale structure of the Universe (Ch. 7)
3/26	Measuring Cosmological Parameters (Ch. 8)
4/2	Measuring Cosmological Parameters
4/9	Measuring Cosmological Parameters
4/16	The high-redshift Universe (Ch. 9)
4/23	Final exam week.

Students are expected to have read the relevant sections of the textbook before class.

The schedule and procedures in this course are subject to changes by the instructor which will be posted on the ASTRON 1121 Courseweb site (and announced in class in the case of major changes). Exam dates are not expected to change, but the exact material covered will be adjusted according to the actual pace of the course.

The Department of Physics and Astronomy

As students at the University of Pittsburgh, you have access to a Physics and Astronomy Department that is highly recognized and is performing world-class research. The Department of Physics and Astronomy wants you to feel welcome. If you are interested in further study of or research in physics or astronomy please talk to me.

You may make use of the undergraduate lounge off of the mail room on the second floor of the Old Engineering Hall. This is a good place to meet with classmates to discuss problem sets and course material. You might also meet physics ma ors here that can help you, discuss other classes with you, or inform you about the major program. The Department also hosts a doughnut and coffee hour every Wednesday at 4PM in Allen Hall which is designed to encourage discussion. The University of Pittsburgh's Astronomy research group hosts seminars on topics of current interest in astronomy and astrophysics every other Friday at Noon in 319 Allen Hall. The talks are typically at an advanced level, but eager students can learn a great deal about contemporary astronomy and astrophysics by attending. There will be additional, somewhat lower-level talks January 11, 22, 25, 29, Feb. 1 and Feb. 5 as part of interviews for faculty candidates (all candidates work in fields related to galaxies and/or cosmology).

Courseweb and Other Resources

The University of Pittsburgh provides a web based resource called *Courseweb*, which is a portal to web sites for individual courses. A *Courseweb* site for this course has been created and from there you may view announcements, send email to the instructor or the TAs, and download course material such as the syllabus and lecture slides. **Reading and homework assignments will all be announced on Courseweb, not in class.** To access *Courseweb* go to http://courseweb.pitt.edu/ .

Use your Pitt email username and password to login to Courseweb. If you have forgotten your username and password or need to set up an account, contact the help desk at 412-624-4357, or 4-HELP. Once you have logged into the system simply click on the link for this course to access the available material.

The Department of Physics and Astronomy provides free assistance for all students. The **Physics Exploration Center** allows students to operate some simple experiments and demonstrations. Within the Exploration Center is the **Physics Help Room** staffed with TAs who can answer homework related questions, explain basic concepts and help you with the math. This is a free service and you are encouraged to use it. The Physics Exploration Center and the Physics Help Room are both located in Thaw 312. In addition, tutoring is available through the Academic Support Center (WPU 311).

Academic Integrity

Students in this course will be expected to comply with the University of Pittsburgh's Policy on Academic Integrity. Any student suspected of violating this obligation for any reason during the semester will be required to participate in the procedural process, initiated at the instructor level, as outlined in the University Guidelines on Academic Integrity. This may include, but is not limited to, the confiscation of the examination of any individual suspected of violating University Policy. Furthermore, no student may bring any unauthorized materials to an exam, including dictionaries and programmable calculators.

Disabilities

If you have a disability that requires special testing accommodations or other classroom modifications, you need to notify both the instructor and the Disability Resources and Services no later than the 2nd week of the term. You may be asked to provide documentation of your disability to determine the appropriateness of accommodations. To notify Disability Resources and Services, call 648-7890 (Voice or TTD) to schedule an appointment. The Office is located in 216 William Pitt Union.