AST 208, Spring 2016

# Planets and Telescopes

# Syllabus

*This one-semester undergraduate course both introduces the practice of astronomical observation and presents the fundamentals of planetary science.*

## Course goals

This course introduces you to the science and practice of modern observational astronomy. In this course you will learn many useful skills of astronomical observation: specifying locations on the sky, detecting the radiation from distant objects, and analyzing astronomical data. As scientific motivation, we will draw on recent discoveries of extra-solar planetary systems.

## Prerequisites

Both Introductory Calculus (MTH 132) and Introductory Calculus-based Physics (PHY 183) are required. You should have received a course preview with sample problems. It is your responsibility to be able to answer the questions on this preview by the start of the class.

## Meeting times and locations

**Lecture** Monday and Friday 12:40–1:30, 1420 BPS

**Lab** Tuesday 5:00p-6:50p, 1300 BPS

This document contains embedded hyperlinks; click on colored text to go to that website.

## Instructors

**Professor Edward Brown (lecture)**

BPS 3266
884–5620
browned@msu.edu
http://www.pa.msu.edu/~ebrown
https://github.com/nworbde
http://twitter.com/nworbde

Office hours: Tuesday 11:00-1:00 or by appointment

**Professor Laura Chomiuk (lab)**

BPS 3276
884–5608
chomiukl@msu.edu
http://www.pa.msu.edu/~chomiuk

Office hours: Friday 1:30–3:30pm or by appointment

**Undergraduate Learning Assistant Edward Buie III**

BPS 1248
buieedwa@msu.edu

Office hours: Thursday 12:00–1:00

**Undergraduate Learning Assistant Andrew Bundas**

BPS 1248
bundasan@msu.edu

Office hours: Wednesday 11:30–1:30

**Undergraduate Learning Assistant Claire Kopenhafer**

BPS 1248
kopenhaf@msu.edu

Office hours: Thursday 10:00–12:00

## Textbook and course materials

1. Barbara Ryden and Bradley M. Peterson. *Foundations of Astrophysics*. Addison-Wesley, 2010.

2. John R. Taylor. *An Introduction to Error Analysis*. University Science Books, 1997.

Notes from the Spring 2015 lecture section of this course are available at this link. We will distribute updated versions of these notes as they become available.

## Online resources and software

Click on each boldfaced item to go to the respective website.

**Anaconda Python** We will use IPython Notebooks for data analysis and some homework problems.

**DS9** We will use this software for displaying astronomical images.

**Desire2Learn** We will post course materials, reading assignments, and a dropbox for labs and selected homework assignments on this website.

**CATME** We will use this online tool to select teams for the lab and to do self- and peer-assessment of the lab exercises. We will send an email with instructions to your MSU account sometime during the first week.

**Stellarium** We will use this free open source planetarium application in the labs; please have this downloaded and installed by the start of the first lab on Tuesday, 12 January.

You will need at least 2 GB of free storage on your device.

## Grading standards

**4.0** Mastery of subject, based on homework, exams, and in-class performance. Able to consistently apply concepts to solve problems. Ready for upper-level coursework.

**3.5** Demonstrates qualities described immediately above and below.

**3.0** Generally understands concepts, but has some difficulties in applying them.

**2.5** Demonstrates qualities described immediately above and below.

**2.0** Incomplete or incorrect understanding of basic concepts.

## Weights for the overall course grade

| Lab | Homework | Quizzes | Final |
|---|---|---|---|
| 40% | 20% | 20% | 20% |

## Homework and reading assignments

Mastering a skill takes practice. Pianists play scales; soccer players juggle; scientists solve problems. Reading the text and taking notes in lecture are not sufficient: you must grapple with a topic until you have constructed your own understanding. The goal is to understand the topic not just well enough to follow a line of reasoning, but well enough to critically assess that reasoning and apply it to new scenarios.

To help you meet this goal, we will assign readings prior to each lecture. The purpose of the lecture is to answer questions, to provide background and context to the reading, and to discuss the assigned problems. We expect you to take an active role in the lecture, and that means coming prepared. In addition to the reading assignments, you should expect roughly weekly homework sets. You will start many of these homework problems in lecture, during group discussions, and then complete them on your own.

Homework sets are due Fridays at the start of lecture. We will assign one of 4 grades: ⊘ (not done), **−** (below expectations), ✔ (meets expectations), **+** (exceeds expectations). Write your solutions in a clear, legible fashion. The grader is not responsible for divining your intent; rather, any solution that is unintelligible or illegible will simply receive a ⊘. We will work through the correct solutions in class. You are responsible for making sure that you understand the solutions—making mistakes, and learning from them, is much less expensive on the homework sets than on the exam!

### Working collaboratively

We have no objection to your working on homework problems collaboratively; the set you turn in must, however, be your own. If you do work on homework solutions in a group, you must list your collaborators and describe their contributions.

## Exams

**Quizzes** There will be a short quiz held every other Friday. Each quiz will cover new material learned in lecture since the last quiz. Although there will be no make-up quizzes, the lowest quiz score, which will include missed quizzes, will be dropped. Quizzes will be closed note (we shall provide relevant formulae as needed) unless otherwise specified.

**Final** Thursday, May 5, 12:45–2:45. The exam format will be closed-book, but we will provide a page of relevant formulae. The final is comprehensive and will include material covered in lab.

## Lab

AST 208 lab will give you a taste of what it's like to be an observational astronomer. As such, you'll be using the tools astronomers use, analyzing real data, and solving real problems (which can sometimes be messy).

Please bring your laptop computer to lab each week. Any operating system (Windows, Mac, or Linux) is okay, but AST 208 lab does require a full computer, not just a tablet.

Collaborations with your classmates is a critical facet of AST 208 lab. Throughout the semester, you will work in teams of 3–4 people. These teams, which will persist throughout the semester, will be assigned during the second week based on your response to an online questionnaire (CATME).

Of your lab grade, 85% will be determined by your reports of the labs, and 15% will be determined via peer and self assessment (on CATME) and by your participation (as observed in lab by Prof. Chomiuk and the TAs). Regular reading assignments will be given before lab, and thought questions will be given during lab that will require group discussion; these will contribute to the participation portion of your grade.

You will occasionally receive a link to a CATME peer evaluation form, where you will assess your own and teammates' work on recent labs. Your answers will remain anonymous (although everyone will receive general feedback on how their group thinks they are performing). Please do your best to be honest, and contact Prof. Chomiuk if you have questions or concerns (or fill out the comment box at the end of the CATME evaluation). The goals of this peer assessment are 1) to stress the importance of being a patient, generous, and hard-working collaborator; 2) to think critically about one's own work and to measure that work against one's own expectations; and 3) to encourage all team members to contribute equally.

Lab reports must be clearly written in full sentences and well organized in content. All python-based labs must be submitted in a single IPython notebook (see the "Lab Report Guidelines" sheet for details on acceptable coding and reporting practices).

Lab reports will typically be weighted according to the number of weeks they stretch over (most labs will only take one week, but some may take two or even three). Lab reports will be due on Monday evenings at 11pm, unless

otherwise noted. No late lab reports will be accepted (so that we can promptly discuss labs in class), but the lowest two lab grades will be dropped.

While you are encouraged to work closely together as a group, we expect every member of the group to understand every part of each lab. You are expected to write your own Python code and make plots individually, in consultation with your team. Every individual student must use their own words in writing up the lab report, and turn in all parts of the lab, independent of teammates.

Consistent with MSU's efforts to enhance student learning, foster honesty, and maintain integrity in our academic processes, we check lab write-ups against published material and other students' work. Any uncited replication of other texts or significant overlap with another student's assignment will be seriously considered as cheating. A violation of academic honesty will result in an undroppable zero on the assignment in question and referral to your dean.

### Observing at the MSU Campus Observatory

We will do at least one lab using the CCD imager at the MSU Campus Observatory. The Campus Observatory is located 1.5 miles south of BPS at the intersection of Forest Rd and College Rd. The campus observatory website `http://www.pa.msu.edu/astro/observ/` has a lot of useful information. Because of the often-cloudy spring semester weather, we may not have many chances to observe the night sky until later in the semester.

Prof. Chomiuk will organize the lab teams to ensure that at least one team member has a car. As part of the first CATME questionnaire, you will indicate which nights of the week you are available for observing (out of Sun., Mon., Tues., Wed., and Thurs.). If you are working on a lab that requires data from the observatory, you may be placed "on call": you will be notified if the sky is clear and your team is expected out at the observatory. You will only be on call during the week nights you are available, and you will told during the lab class period if/when your team will be on call in the upcoming week.

## Disability accommodations

Students who require disability accommodations should bring their VISA forms to both Prof. Brown and Chomiuk during the first week of classes. If you require accommodations but have not yet registered as a student with a disability, please register with the MSU Resource Center for Persons with Disabilities at `https://www.rcpd.msu.edu/services/accommodations`.

## If there is a conflict

Disagreements and conflicts occur from time to time and are a fact of life; what is important is that they are swiftly and satisfactorily resolved. If you are unhappy about any aspect of the course, we propose a "24–48" rule: please bring your complaint to our attention promptly, within 24 hours of the issue arising; in turn, we shall evaluate your complaint and respond within 48 hours.

## References—astronomy

Jeffrey O. Bennett, Megan O. Donahue, Nicholas Schneider, and Mark Voit. *The Cosmic Perspective*. Addison-Wesley, 7th edition, 2013.

Bradley W. Carroll and Dale A. Ostlie. *An Introduction to Modern Astrophysics*. Addison-Wesley, 2d edition, 2006.

Jack J. Lissauer and Imke de Pater. *Fundamental Planetary Science: Physics, Chemistry and Habitability*. Cambridge University Press, 2013.

Barbara Ryden and Bradley M. Peterson. *Foundations of Astrophysics*. Addison-Wesley, 2010.

Frank H. Shu. *The Physical Universe*. University Science Books, Sausalito, CA, 1982.

## References—physics

Enrico Fermi. *Thermodynamics*. Dover, 1956.

Bernard Schutz. *A First Course in General Relativity*. Cambridge University Press, 2009.

D. J. Tritton. *Physical Fluid Dynamics*. Oxford University Press, 2d edition, 1988.

## References—probability

Richard Courant, Herbert Robbins, and Ian Stewart. *What is Mathematics?* Oxford University Press, 2d edition, 1996.

Richard Durrett. *The Essentials of Probability*. Duxbury Press, Belmont, CA, 1994.

Jim Pitman. *Probability*. Springer-Verlag, New York, 1993.

John R. Taylor. *An Introduction to Error Analysis*. University Science Books, Sausalito, CA, 2nd edition, 1997.

## References—programming (all free)

Software Carpentry. Lessons, 2015. URL http://software-carpentry.org/lessons/.

Allen Downey. *Think Python*. Green Tea Press, 2nd edition, 2013. URL http://www.greenteapress.com/thinkpython/thinkpython.html.

## References—writing & graphics

Steven Pinker. *The Sense of Style*. Viking Penguin, New York, 2014.

William Strunk, Jr. and E. B. White. *The Elements of Style*. Longman, 4th edition, 1999.

Edward R. Tufte. *The Visual Display of Quantitative Information*. Graphics Press, Chesire, CT, 2d edition, 2001.

Edward R. Tufte. *Beautiful Evidence*. Graphics Press, Chesire, CT, 2006.