AST 208, Spring 2015

Planets and Telescopes

Syllabus

This one-semester undergraduate course 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 the recent extraordinary discoveries of extra-solar planetary systems.

Meeting times and locations

Lecture Monday and Friday 11:30–12:20, 1420 BPS

Lab Tuesday 8:00p-9:50p, 1300 BPS

Instructors

Associate Professor Edward Brown (lecture)

BPS 3258
884–5620
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http://www.pa.msu.edu/~ebrown
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Office hours: Friday 12:30–2:30pm or by appointment

Assistant Professor Laura Chomiuk (lab)

BPS 3276
884–5608
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Office hours: Tuesday 1:00–3:00pm or by appointment

Graduate Teaching Assistant Laura Shishkovsky

BPS 3265 shishko1@msu.edu

Office hours: Thursday 3:00–5:00pm

Undergraduate Learning Assistant Andrew Bundas

BPS 1248 bundasan@msu.edu

Office hours: Monday 3:00–4:00pm and Wednesday 12:00-1:00pm

Textbook and course materials

Jack J. Lissauer and Imke de Pater. *Fundamental Planetary Science: Physics, Chemistry and Habitability*. Cambridge University Press, 2013.
An electronic version of this book is available from Amazon for $37.

Online resources and software

Click on each boldfaced item to get the respective website.

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

VirtualBox We have critical software[1] for scientific computing preloaded on virtual machines. To use these virtual machines, please download and install this free application by the end of the first week of class.

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, 13 January.

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

[1] The virtual machines include Ubuntu™ linux distributions preloaded with Anaconda Scientific Python and DS9 image display software.

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 and problems 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.

For most reading and problem sets, we will assign one of 4 grades: ⊘ (not done), − (below expectations), ✔ (meets expectations), + (exceeds expectations). Note that a grade of ✔ or + *does not guarantee* that the set is done correctly; it just means that the set appears to be on the right track. Write your solutions in a clear, legible fashion. The grader is not responsible for divining your intent; she will simply assign a zero to any solution that is unintelligible or illegible. A few problem sets, randomly chosen, will be graded in detail. 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!

We have no objection to your working on homework problems collaboratively; the set you turn in, however, must be your own.

> *No rule of scientific etiquette is more important than acknowledging the contributions of others.*[2]

If you do work on homework solutions in a group, you must list your collaborators and describe their contributions.

Exams

Quizzes Expect short quizzes roughly every other week. The level of difficulty will be comparable to a short homework problem or reading assignment. Many of these quizzes will be open-note. The lowest two quiz scores, including any ones that were missed, will be dropped. There will be no make-up quizzes.

Final Thursday, May 7, 10:00a–12:00p. 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.

[2] K. S. Thorne 1987, *Some Specific Tips About Technical Writing*.

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 ok, 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 write-ups to 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 thought questions will be given in 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 write-ups must be clearly written in full sentences and well organized in content. All python-based labs must be submitted in a single IPython notebook (accessible via the VirtualBox software). 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 strongly encouraged to write your own Python code and make plots individually, in consultation with your team. Every individual student must turn in all parts of the lab, independent of teammates.

Lab write-ups 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 write-ups will be due on Tuesdays at the beginning of lab unless otherwise noted. For each day the write-up is late (including Saturday and Sunday), 10% will be deducted from your grade for that write-up.

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.

Weights for the overall course grade

Lab	Homework	Quizzes	Final
40%	20%	15%	25%

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.

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 disabil-

ity, 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.

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, 2014. URL http://software-carpentry.org/lessons.html.

Allen Downey. *Think Python*. Green Tea Press, 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.