AS 202 - PRINCIPLES OF ASTRONOMY I

Syllabus - Fall term, 2013

Course Perspective:

AS 202 is an introductory astronomy course aimed primarily at physical science majors. This class surveys the historical development of astronomy, the motion of the planets, the formation of the solar system, and the characteristics and evolution of the Sun, planets and Earth. In studying astronomy and the solar system, we will explore one of the most exciting endeavors in human history. Today, we find ourselves in a golden age of astronomical and planetary science, with new discoveries enhancing our understanding of the Cosmos on an almost weekly basis. We will discuss recent discoveries and the scientific method which have enabled us to make them.

AS 202 is a required course for students concentrating in astronomy or planetary and space science and a prerequisite course for the astronomy and physics concentration. In addition, it fulfills the natural science distribution requirement of the College of Arts and Sciences. Hence, the primary purpose of AS 202 is not to teach a series of facts about the solar system, but to study the methods and tools with which scientists have unraveled and continue to explore the inner workings and composition of the solar system. These scientific methods enable us to go beyond simply describing the current state of the solar system, allowing deductions about its past and predictions about its future.

As the great 17^{th} century scientist, Galileo Galilei, stated, "The language of the universe is mathematics." The physical sciences, (astronomy, physics, chemistry and related fields) rely on the predictive capabilities of mathematics. While college level calculus and physics are not prerequisites, calculus 1 is a co-requisite and most of the students enrolled in this class are currently taking physics (PY251 or 211). If you are enrolled in AS202 and are uneasy about the expected mathematics and physics, but still have a desire to study astronomy, you should consider one of the 100-level Astronomy courses that are geared principally for non-science majors. If you have already taken AS101, this course will be highly redundant and, if you are not planning to major in an astronomy concentration, we recommend an alternate class such as AS102, AS117 or AS311. If you have taken AS101 and plan to major in an astronomy concentration, talk to the professor immediately. If you are a natural science or math major or wish an analytical approach to studying astronomy then AS202 and AS203 should be appropriate. For more advanced students with some astronomy and planetary sciences background, AS311 provides a mathematically more advanced course in solar system physics without a lab or observational component.

AS 202 moves quickly through a great deal of material and each topic builds on earlier material. If you fall behind, you may find it difficult to catch up. If you get stuck on a concept, move on and seek help from the professor, teaching fellows, or your classmates. We hope that the rewards of learning about the mysteries of the heavens and the solar system will make all the demands and requirements of AS 202 worthwhile.

Instructor: Professor Meers Oppenheim

Office: CAS Room 517, work phone: 353-6139, home phone: 617-965-7345, e-mail: meerso@bu.edu

Office Hours: Wed: 12:00-1:00pm in CAS 502, and & Wed. 3-4pm Thurs: 1:30-2:30pm in CAS 517 except when announced. Open door policy: Feel free to stop by anytime or make an appointment.

Teaching Fellows:

Ms. Ren Cashman: CAS Room 524

Office Hours: Tue. 1:00-2:30, Thu. 10:30-12:00 e-mail: lcashman@bu.edu

Mr. Mark Veyette: CAS Room 524

Office Hours: Wed. 12:00-1:30, Thu. 2:30-4:00 e-mail: mveyette@bu.edu

Contacting us: E-mail is usually the easiest method of contacting the professor or teaching fellows. We all check our email daily—often hourly. Also, feel free to telephone us or stop by during office hours or at other times.

Twitter account: Ren and Mark are also reachable over the class Twitter account, **@BU_AS202**. They will be using it to tweet interesting astronomy links and news stories during the semester, as well as to announce whether night lab will be held. Using Twitter is not a required element of the course, but if you are interested in astronomy, it can be a way to see how what we learn in the course fits within the context of such a quickly-moving field of research. Please feel free to follow us, tweet us interesting links, ask questions, and add your voice to the conversation!

Dates:

First Lecture:	Sep	4
First Lab:	Sep	9
Planetarium show 1:	Sep	30 (6:30-8:00)
Planetarium show 2 & 3:	Oct	1, 2 (6:30-8:00)
Columbus Day Holiday (class held on Tue)	Oct	14
Exam 1:	Oct	11
Exam 2:	Nov	15
Final:	Dec	18 12:30-2:30pm

Required Text: *The Cosmic Perspective: Solar System* (7th edition) by Bennet, et. al[1]. The book and the lectures complement each other and students are responsible for the material in both. Students are expected to read the sections listed in the "Course Outline" found below.

More advanced text: *Foundations of Astrophysics* by Ryden and Peterson. Similar material covered at a sophomore level of physics and mathematics.

More advanced text: *Astronomy: A Physical Perspective* by Marc Kutner. This book explores astronomy at a more sophisticated level than does the Bennet book. However, it does not contain sufficient detail on recent advances in planetary science and it contains a number of typographical errors in its analysis and constants.

More advanced text: *Physics and Chemistry of the Solar System* by John S. Lewis, Academic Press. This book includes many of the more advanced topics covered in AS202 lectures which *The Cosmic Perspective* does not cover. It does not cover the general astronomy we examine in the beginning of this class.

Another good Text: *Worlds Apart* by Consolmangno and Schaefer. Out of print but can be ordered (suggestion: search the web).

Books in Library Reserve: [2]

1. *Norton's Star Atlas*, by Arthur P. Norton, published by Sky Publishing Corp., Cambridge, MA.
2. *The New Solar System (3rd edition)* contains more detail on the solar system, edited by J. Kelly Beatty, Brian O'Leary, and Andrew Chaikin, published by Cambridge University Press and Sky Publishing Corporation, Cambridge, UK and MA, 1990.
3. *Introductory Astronomy and Astrophysics* by Zelick & Gregory is a sophomore/junior level text containing more mathematical detail and insight.

Lecture Hours and Location: Lectures (A1) - Mon, Wed & Fri: 11:00-11:50 am, room: CAS 502

[1] Text is available in the CAS Course book section of the Boston University Bookstore in Kenmore Square.

[2] These texts and others suggested throughout the term as optional resources, will be available in the Astronomy Library located on the sixth floor of CAS above the astronomy department offices.

Grades: The final course grade depends upon four course components and their weights:

Highest of 2 midterm exams	20%	Final Exam	35%
Problem sets (∼12 anticipated)	9%	Observing/Lab Exercises	35%
Participation	1%	Bonus - Telescope checkout	1%

Problem Sets: Weekly problem sets will be distributed in class during the semester. Generally, they will be due on Fridays. Solutions sets will generally be handed out on the due-dates so that students can immediately self-evaluate their understanding of the material. **The course policy is that NO assignments will be accepted after the announced due date.** If extenuating circumstances develop, please discuss the situation with the instructor.

Students should submit solutions that show a clear progression through the problem, with sentences and diagrams supporting the math. Write neatly on a single side of a page, and move to a fresh page where necessary rather than crowding yourself. Points are awarded for properly setting up the problem, carrying through a solution, and arriving at the correct answer.

We will assign a grade for each problem set by evaluating a random subset of the problems. This means that we will grade only 1/4-3/4 of the problems assigned. When computing the students final grade, we will drop the problem set with the lowest grade. Even if a student has receive excellent grades on all but one problem set, we do not recommend that he or she skip the final problem set since these problems are good preparation for the exams. **Also, each exam will contain an almost verbatim problem from a problem set.**

Labs/Discussion Section:

AS202 is a laboratory course where lab participation and lab reports constitute a major part of your final grade. The lab is composed of four components. First, the indoor labs and discussion sections will be from 5:00-6:30 in assigned sections. **Each student must be enrolled in one of the lab sections (A2-4) in addition to the lecture (A1)!** Second, the nightlabs will be after sunset on Mon, Tue, or Wed at a time specified by the teaching fellow (TF). Students should attend nightlab on the same night they attend indoor lab. Students in the Wednesday daylab section should sign up with their TF for a Mon, Tue or Thu nightlab section. If a student cannot attend nightlab on a particular night, then the should discuss alternate times with a TF as early as possible. The third lab will consist of a small observing project called "Phases of the Moon." Fourth, planetarium shows will be held at the Boston Museum of Science, plan to attend one of these shows.

The Lab and Planetarium Exercises grade will derive from 5 indoor lab exercises, 2-4 observing lab exercises which count 1 to 2 times as much as the daylab and a planetarium exercise.

Indoor Labs/Discussion Section: Indoor lab will usually begin with a discussion of material presented in lecture and/or problem sets followed by a brief introduction to the laboratory and then the laboratory itself. These labs will demonstrate a certain physical principle or elaborate on lecture material. The following table lists the meeting times and locations of each section:

Sections	Day	Time	Location
A2	Mon.	5:00 - 6:30 pm	CAS Room 521
A3	Tue.	5:00 - 6:30 pm	CAS Room 521
A4	Wed.	5:00 - 6:30 pm	CAS Room 521

Students unable to attend their scheduled lab should discuss possible substitutions with the teaching fellows at the earliest possible time.

The following table shows the indoor lab schedule:

Week	A2	A3	A4	Lab Name
1	Sept. 9	Sept. 10	Sept. 11	Orientation, Night Sky, & Video
2	Sept. 16	Sept. 17	Sept. 18	Planetary Motions & Telescopes
3	Sept. 23	Sept. 24	Sept. 25	Telescopes Continued & Error Analysis
4	Sept. 30	Oct. 1	Oct. 2	Luminosity & Brightness
5	Oct. 7	Oct. 8	Oct. 9	Exam Review
6	Oct. 15	Oct. 22	Oct. 16	Solar Rotation, Spectroscopy, & Doppler
7	Oct. 21	Oct. 29	Oct. 23	Solar Rotation Cont.
8	Oct. 28	Nov. 5	Oct. 30	TBD
9	Nov. 4	Nov. 12	Nov. 6	Exoplanet and Kepler Light Curves
10	Nov. 11	Nov. 19	Nov. 13	Cratering and Surfaces of Terrestrial Bodies
11	Nov 18	Nov. 26	Nov. 20	Cratering Cont.
12	Nov 25	Dec. 3	Dec. 4	Analyze nightlab data II
13	Dec. 2	Dec. 10	Dec 11	Final Exam Review

Students must keep a lab notebook with a record of the data collected and extensive notes on difficulties and sources of errors. For most labs, students will turn in this lab notebook which will be graded.

For two of the day-labs, students will complete a full lab report. Typically, the lab report will be due one week after completion of the lab. The lab report should be organized as follows: (1) Begin with an introduction, explaining the purpose of the lab and the hypothesis being evaluated. (2) Describe the equipment and techniques used. (3) Report the **raw** data. (4) Include the analysis where the data is reduced and analyzed. (5) Conclude with a discussion of whether the hypothesis was or was not validated by the experiment performed and why or why not. The lab report must be typed or written very legibly.

Night Labs: Nightlabs enable students to become familiar with the night sky and in the use of telescopes as an astronomical tool. The following table lists the meeting times and locations of each section:

Sections	Day	Time	Location
Nightlabs	Day	Time	Location
A2	Mon.	specified by TF	Observatory
A3	Tue.	specified by TF	Observatory
A4	Wed.	specified by TF	Observatory

The J. B. Coit Observatory can be found on the roof of the CAS building, two floors above the astronomy department. The observatory has set of celestial pipes and telescopes.

Because of inclement weather, it is not uncommon to have an entire month with **no** clear Tuesday nights. Hence, it may become necessary to modify the nightlab schedule. The observatory is outside, unheated, and often bitterly cold, so dress appropriately. We recommend over dressing. **The nightlab TF will send an email to the students indicating whether the observatory will be open on a given night.**

We currently plan to have three nighttime projects: (1) Observing the Night Sky, Telescopes, and Imaging Saturn, Venus and the Moon; (2) Motions of the asteroid Juno, and (3) Tracking Jupiter and its Moons. The first lab will orient the students and prepare them for qualifying to use the telescopes independently. The last two labs will require a lab report similar in form to the indoor labs. Due dates depend on weather conditions and will be announced. In addition, we have a solar/planetary telescope with a spectrometer located in CAS 521. We plan to use this to look at solar and, possibly, Jovian spectral lines and Doppler shifts. However, these labs are still under development and the lab program will develop as the semester progresses.

Class www site: *http://learn.bu.edu/* - Most of the course handouts will be posted here. Your grades will be recorded here and available for you to inspect.

Other Astronomy Resources and Web Sites:

1. *www.masteringastronomy.com* - Site associated with the book contains chapter summaries with a hyper-linked glossary, practice quizzes, and resources including movies and animations.
2. *www.colorado.edu/physics/2000/* - Well done site explaining modern physics with cartoon characters and JAVA applets.

3. *phet.colorado.edu* - More advanced JAVA applets designed to teach physics and astronomy.
4. *jersey.uoregon.edu/vlab/* - JAVA applets designed

Note on attendance: Boston University's policy on attendance is "Boston University expects each student to attend each class session unless they have a valid reason for being absent." Students who miss an occasional lecture should review the material covered with another student. Students who must miss a day or night lab should discuss other times at which the lab can be done with their teaching fellow at the earliest possible time. In the event of an absence exceeding a few days, please notify the teaching fellow or professor.

Course Outline:

1. Introduction to Astronomy
2. The Night Sky
3. History of Astronomy - Ancient Observers to Newton
4. Planetary Dynamics
5. Energy & Matter
6. Light & Spacecraft
7. Overview and Evolution of the Solar System
8. The Sun - From the center to the edge of the solar system
9. Exoplanets
10. Geology of Terrestrial planets
11. Atmospheres of Terrestrial planets
12. Gas Giants
13. Jovian Moons
14. Asteroids, Comets and Pluto
15. Earth
16. Life beyond Earth???

Common Courtesy Guidelines: For the benefit of your fellow students and your instructors, you are expected to practice common courtesy with regard to all course interactions. For example:

- Show up for class on time.
- Turn off your cell phones before class begins!
- Do not leave class early, and do not rustle papers in preparation to leave before class is dismissed.
- If you must be late or leave early on a particular day, please inform your instructor or TF in advance and then enter, leave and sit by the rear door.
- Be respectful of your classmates and teachers.

Important Note on Academic Conduct: Students are encouraged to collaborate with each other when solving the problem sets and/or laboratory exercises. However, each student must independently write-up the problem sets and the labs. If two assignments are overwhelmingly similar or identical, then that will be considered a form of academic misconduct. Boston University takes a very hard stand on any form of academic misconduct and is prepared to act swiftly and seriously. Accordingly, in instances where you have worked with another student on an assignment, make it painfully clear that the written solutions represent your own understanding of the problem.