# AS102 – The Astronomical Universe
## Spring Semester – 2016
## Syllabus

One of the great achievements of modern science is to understand where we are in space and time. Since the 1920's, we have known our cosmic address in the Milky Way galaxy, and from the 1930's on we have been refining our understanding of where we are in the history of the universe. This perspective has been hard-won, through persistent questioning, observation and creative thinking, and its historical development parallels the development of the process of science. It has also led to our present efforts to understand the origin and evolution of life as well as the future of our planet and the very existence of humanity.

In this course we will examine how we came to our present understanding of our place in the universe and explore its contents. One of main themes will be to continue to explore how we know what we know, whether in discussing the evolution of stars, the nature of galaxies, or the earliest moments and future trajectory of the Universe as a whole.

**Course Objectives:**

During this course, it is expected that you will achieve several goals. These are:

1) to understand the global and local properties of the Universe, including the types of objects, and where they're located;

2) to appreciate our place in space and time: the size, scale and age of the solar system and its location in the Galaxy and in the history of the universe;

3) to appreciate the importance of various physical concepts in a variety of circumstances, such as gravity on different scales, and angular momentum.

4) to understand the tools astronomers use to understand what light tells us, particularly spectroscopy and the nature of the atom;

5) to appreciate the life history of stars, from nebulae to their final endpoints as white dwarfs, neutron stars or black holes;

6) to understand why the Big Bang model is taken seriously by scientists;

7) to appreciate science as a process by gathering and analyzing data, and by using critical reasoning to solve problems.

**Course Expectations:**

You should expect to spend **at least** 10-15 hours per week outside of class preparing for lectures, reviewing lectures, working on assignments and labs, and thinking about the concepts of the course. This course will use math at the level of basic algebra (solving for unknowns in equations with three variables, finding ratios, etc.) and trigonometry. If you are weak in this department, I encourage you to consult Appendix C in the text (see below) or to see me.

Also, in any group work, you are expected to be a full participant, even if the group meets outside of class time. You may be working in pairs for the labs and both partners are expected to work on all parts of the lab together. Dividing the work is neither advisable nor acceptable.

**Class Hours:**

T, Th 11:00-1220, CAS 314.

*Attendance is expected at every class.*

**Instructor:**

Dr. Daniel Hudon (Office CAS 418A), hudon@bu.edu

Office Hours: Tues 1030-11, 1230-1 or by appointment.

**Text:**

Recommended: Bennett et al, *The Cosmic Perspective, 6th Edition/Stars and Galaxies*

Recommended: *The Bluffer's Guide to the Cosmos,* Daniel Hudon

**Resources:**

Lecture notes and handouts will be available on learn.bu.edu

The textbook comes with access to Masteringastronomy.com, a website that contains textbook exercises, self quizzes, tutorials, interactive figures and videos. You are strongly encouraged to explore the topics covered in lecture on this site.

Another good resource is Nick Strobel's Astronomy Notes: www.astronomynotes.com

Please also make regular visits to the Astronomy Picture of the Day: http://antwrp.gsfc.nasa.gov/apod/astropix.html

**Lab Exercises:**

Once per week, the class meetings will consist of laboratory exercises intended to illuminate some of the concepts being discussed in the lectures. These will meet in CAS Room 521 or in B04. The materials relating to a particular lab will generally be handed out in class the day before the lab or you may be asked to print them from Blackboard. They will be due soon thereafter. Labs may change due to availability of equipment so stay tuned for announcements or emails.

Weather and time permitting, one lab will be performed at night.

There will **not** be an opportunity to make up labs due to absences.

**This course satisfies a lab requirement, so a grade of less than 50% on two or more labs will result in an F in the course.**

**Lab Schedule:**

| Number | Title |
|---|---|
| 1. | Powers of Ten and Angular Measurements |
| 2. | Parallax |
| 3. | Gravity |
| 4. | Spectroscopy |
| 5. | Luminosity |
| 6. | Hubble's Law |
| TBA | Night Lab |

**Exams:**

There will be a midterm exam on Tues Mar 1 and a cumulative final exam to be scheduled by the Registrar. Each exam will have the same format of multiple choice, short answer questions and possibly an essay question. You may also be asked to perform a calculation of the sort done in lecture or on the homework assignments. Equations will be given on a cover page, but not generally for particular problems. There will NOT be an opportunity to make up exams due to absences.

**Problem Assignments**:

The best way to learn astronomical concepts is by thinking about conceptual or quantitative problems. Hence, problem assignments will be handed out on a regular basis and due one or two weeks later at the beginning of lecture. You should work at them **every day** because you probably won't be able to complete them if you leave them until the night before they are due.

Assignments may be worked on in groups of 2, 3 or 4 students. Once your group is set up, plan to have meetings well in advance of the due date and come to meetings with as much of the assignment done as possible. Assignment material may appear on exams so be sure to participate in the entire assignment. Solutions should be in your own words and sketches should be done by you. Plagiarism (passing off another person's work or the work in a published source as your own) will not be tolerated. Only paper (not electronic) versions of the homework are accepted.

Late work is NOT accepted.

**Quizzes**

Some lectures will have a quiz at the beginning, middle or end. These will be multiple choice and short answer questions. You may also have to sketch something. These are designed to make sure you are keeping up with the readings. Worksheets done in class, as well as your attendance and participation, will count towards your participation grade.

**Assessment:**

| | |
|---|---|
| Labs: | 25% |
| Problem Assignments | 20% |
| Midterm Exam | 20% |
| Final Exam | 25% |
| Participation | 5% |
| Quizzes | 5% |

There are no opportunities for extra credit.

**Teaching Fellow**

I am pleased to welcome Taylor Hogge to the course. He will assist with running the labs and will also be available for homework and conceptual help. He will hold office hours TBA and you may email him at thogge@bu.edu to set up additional appointments.

**Planetarium Show**

Mark your calendars for Feb 8 and 9 at 6pm to go to the Museum of Science planetarium! You may attend either show.

**Course Outline**

| Date | Topic | Reading |
|---|---|---|
| T Jan 19 | 1. Science Intro and Scale of the Universe/Grand Tour | Chapter 1 |
| Th Jan 21 | 2. Motions in the Sky (retro motion, seasons) | Chapter 2 |
| T Jan 26 | 3. Greek Astronomy (size of Earth, distances of sun/moon), models Copernicus, Tycho, Kepler | Ch. 2, 3 |
| Th Jan 28 | 4. Models II: Kepler, Galileo and the Telescope | Ch. 3 |
| T Feb 2 | 5. Newton, gravity and orbits | Ch. 4 |
| Th Feb 4 | 6. Einstein's Universe I | S2, S3 |
| T Feb 9 | 7. Einstein's Universe II | S3 |
| Th Feb 11 | 8. Light and Matter I | Ch. 5 |
| T Feb 16 | No class – substitute Monday schedule | |
| Th Feb 18 | 9. Light and Matter II | Ch. 5 |
| T Feb 23 | 10. The Sun | Ch. 14 |
| Th Feb 25 | 11. Measuring Stellar Properties | Ch. 15 |
| T Mar 1 | !!!!!! Midterm Exam !!!!!! | |
| Th Mar 3 | 12. Star Birth | Ch. 16 |
| T/Th Mar 8/10 | Spring Break | |
| T Mar 15 | 13. Life Cycles of Stars I: Low-Mass Stars | Ch. 17 |
| Th Mar 17 | 14. Life Cycles of Stars II: High-Mass Stars | Ch. 17 |
| T Mar 22 | 15. Stellar Remnants I | Ch. 18 |
| Th Mar 24 | 16. Stellar Remnants II | Ch. 18 |
| T Mar 29 | 17. The Milky Way Galaxy | Ch. 19 |
| Th Mar 31 | 18. Galaxies and Hubble's Law | Ch. 20 |
| T Apr 5 | 19. Galaxy Evolution | Ch. 21 |
| Th Apr 7 | 20. Dark Matter and Dark Energy | Ch. 22 |
| T Apr 12 | 21. The Big Bang I | Ch. 23 |
| Th Apr 14 | 22. The Big Bang II | Ch. 23 |
| T Apr 19 | 23. The Inflationary Universe | Ch. 23 |
| Th Apr 21 | 24. Life in the Universe | Ch. 24 |
| T Apr 26 | 25. Odd and Ends | |
| Th Apr 28 | 26. Odds and Ends | |

Subject to change. Announcements will be made in class.