Astronomy 142: Spring 2016

The Evolving Universe:

Recent Theories and Observations in Modern Astronomy

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OFFICE HOURS: Mon. 10-11 & 1-2,
Wed. 10-11 & 3-4,
Thurs. 11- noon (Feel free to make an appt. for other times!)
Look for me in CHCB 13 if I'm not in my office!

Course meets: M, W, F 9:10-10:00 a.m. in CHCB 230/231
and M 3:10 – 5:00 p.m. in CHCB 230/231 or CHCB 13
Weather permitting, we may also have a few night meetings for astronomical observing.

Moodle: All course announcements, resources, and materials will be on the *Evolving Universe* Moodle course supplement.

Readings: **Required Texts**

1. *An Introduction to the Sun and Stars, 2nd edition*
   edited by Simon Green and Mark H.Jones
2. *An Introduction to Galaxies and Cosmology, 2nd*
   edited by Mark H. Jones, Robert J. A. Lambourne, and Stephen Serjeant

Magazine and journal articles:

Since we are exploring current topics in the field of astronomy, some course readings will be taken from periodicals and journals such as Nature, Science, Scientific American, Sky and Telescope, etc. You will be able to access these articles as links on Moodle or through the Mansfield Library e-journals.

Supplies: Scientific calculator, headlamp or small flashlight. For some labs it may be nice to have your own laptop, but this is not essential.

Course Description

New technologies and space-based observations have fueled a renaissance in our understanding of the universe. From the discovery of extrasolar planets, to theories postulating the properties of dark matter, dark energy, and accelerated expansion, we will explore many of the exciting, recent advances in the field of astronomy. How has the intricate interplay between theory, observation, and experiment evolved our understanding of the universe? What fundamental questions remain?

Learning Objectives

- To gain a basic understanding of many of the methods astronomers use to study the universe
- To gain a working knowledge of some of the basic physics that astronomers use to understand the universe (properties of light, matter, motion, and force)
- To gain an appreciation of how astronomical ideas have evolved over recent decades
- To learn how to access resources useful for following developments in the field and explore opportunities for accessing astronomical information, datasets, and research opportunities
- To get an overview of some of the important research topics in astronomy today
- To discover fundamental questions which remain

Course Requirements

This course will require you to think critically, conceptually, and quantitatively. It will give you lots of opportunities for hands-on explorations through laboratory, computer, and astronomical observing activities integrated throughout the course. Everyone will be expected to be an active participant in class discussions, projects, and activities.

Your grade for this course will be based on the following:

Exams (2 midterms: 15% each; 1 final: 20%):		50%
Laboratory and Class Discussion activities:		25%
Homework:		15%
Project:		10%
Extra Credit:	up to	4%

(instructor's discretion for outstanding projects, participation above and beyond, etc.)

Exams: Each exam will be short answer (conceptual and quantitative) and comprehensive. No make-ups will be given for midterms or the Final unless prior arrangements are made (for exceptional, documentable circumstances) or an unexpected (documentable) emergency.

Laboratory activities: This class will be blurring the distinction between participatory demonstrations and bona fide laboratory activities. As we go through the semester, some activities will be much more in-depth than others. I will assign a point system for discussion activities and labs based on their length and difficulty.

Homework: These assignments will give you insight into the more quantitative aspects of the course and encourage you to explore current research. Homework assignments will be due every 1-3 weeks. DO NOT leave these assignments until the last minute! DO NOT hesitate to come see me outside of class with any questions you may have. I am very happy to discuss homework questions with you *before* they are due!

Project: Over the course of the semester, you will be involved with a research project of your choice. These projects can be done in groups of 2-4 students (this will make the workload quite manageable), or you can work by yourself if you prefer. Different types of projects will lend themselves to different sized groups. I will provide a list of possible project topics that complement what we will be covering in class, but I encourage you to suggest other topics that reflect your particular interests. I will have checkpoints throughout the semester to help you keep your project on track. NOTE: I do not expect you to do original research here, but I do expect you to gather and analyze data and investigate something new to *you*.

Each group will be tasked with the following:

1. Research the topic by accessing both fundamental background literature and a variety of recent, peer-reviewed research articles. Depending on your topic, you will want to access appropriate astronomical datasets or take some of your own astronomical observations.
2. Construct a well-written, illustrated (with relevant tables, graphs, and/or images) Moodle wiki page on your research. As per standard Wiki format, all references should be cited in the text and listed at the end of your page. Making your own high quality visuals will earn you extra points!
3. Each group will need to schedule a meeting with me after their wiki is complete but before they present their results to the class.
4. Each person will be asked to peer review another project's wiki prior to project presentations. Your review must be typed with one copy submitted to the group and one copy to your instructor. Each group must address any issues brought up by your instructor and peer reviewers before project completion.
5. Each person will be required to read each project wiki prior to class presentations.
6. Each group will present a 10 minute (max) power point overview of what you found to be the most intriguing aspects of your topic/results to the class, to be followed by a general class discussion that your group will moderate.
7. Each person will write-up a brief description of the contributions of *each* group member to sign and turn in individually at the end of the project. (Groups only.)

Note: Everyone in your group should be able to intelligently discuss your topic, but it is EXPECTED that you will divide up tasks according to the individual expertise of your group members. Groups with diverse backgrounds will be very useful. Science background, math background, creativity, writing skills, artistry,

research skills, organizational skills, etc, will all be equally important qualities to have within your group members. Curiosity and a good work ethic will undoubtedly be most important!

Participation: Active and thoughtful participation will undoubtedly influence your final grade in this class. Come prepared to think, question, and contribute!

Academic conduct statement:

All students must practice academic honesty. Academic misconduct is subject to an academic penalty by the course instructor and/or a disciplinary sanction by the University. All students need to be familiar with the Student Conduct Code. The Code is available for review online at http://www.umt.edu/vpsa/policies/student_conduct.php.

EQUAL ACCESS: A fair and inclusive learning environment benefits us all. If you have any issues that you are concerned about, please contact me within the first few days of class to discuss appropriate accommodations. If you think you may have a disability and have not registered with DSS, please contact them in Lommasson 154, call (406) 243-2243, or view the DSS website at http://life,umt.edu/dss. The folks at DSS are very helpful!

ADD/DROPS: The last day to add/drop on Cyber Bear is Friday, February 12. The last day to use a Drop/Add form to drop or change grading option, with the signatures of your instructor and advisor is Monday, March 28. A drop, or change of grading option after March 28 requires the signature of the Dean and written documentation of exceptional circumstances.

Brief Course Outline

Note: Detailed schedule information, assignments, learning objectives, and all course materials will be posted throughout the semester on Moodle. You should be accessing the Moodle course supplement frequently!

WEEK	DATES	TOPIC	READINGS
1	Jan 25-29	Introduction to course A sense of place and scale Getting familiar with the night sky Learning to read the stories told by light	**Sun and Stars** Box 1.1, 1.2,1.3, Section 1.3.2 Peruse the links and resources on Moodle and get familiar with e-journal resources at the Mansfield Library
2	Feb 1-5	The Sun- Observations and fundamentals Solar structure and variability	Remainder of Chapter 1 Chapter 2
3	Feb 8-12	Measuring stellar properties	Chapter 3
4	Feb 15-19	**Holiday Monday- President's Day** Stellar properties and the H-R Diagram	Chapter 4
5	Feb 22-26	Star and Planetary system formation **Friday, Feb. 26: EXAM 1**	Chapter 5
6	Feb. 29-Mar. 4	Discovering planets beyond the solar system- Discovery methods, surprises, insights, and questions	Chapter 5
7	Mar 7-11	The evolution of stars	Chapter 6-8
8	Mar 14-18	The death of stars- stellar remnants White dwarfs, neutron stars, and black holes	Chapter 9
9	Mar 21-25	Exploring our own galaxy- the Milky Way	**Galaxies and Cosmology** Chapter 1-2
10	Mar 28-Apr 1	The structure and evolution of galaxies through time **Friday, April 1: EXAM 2**	Chapter 3-4
11	Apr 4-8	**SPRING BREAK**	
12	Apr 11-15	Modeling the universe: Hubble's discovery and recent developments	Chapter 5, Chapter 7.2-7.3
13	Apr 18-22	Important cosmological parameters and possible models	Chapter 5
14	Apr 25-29	Evidence supporting the Big Bang	Chapter 6-7
15	May 2-6	Outstanding questions	Chapter 8
16	May 11	**Final Exam is Wednesday, May 11 from 10:10 a.m. – 12:10 p.m.**	