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ASTR 132N.Y1: Stars, Galaxies and the Universe

Nathan T. McCrady
University of Montana - Missoula, nate.mccrady@umontana.edu

Astronomy 132: Stars, Galaxies and the Universe

University of Montana, Spring 2017
Tu/Th 9:30 – 10:50 am
Urey Lecture Hall 101
Course Number 30019

Professor: Dr. Nate McCrady
e-mail: nate.mccrady@umontana.edu
Office: 122 CHCB
Office Hours: Tu/Th 11am-noon, Th 3-4pm, Fri 1-2pm and by appointment

Course Description

In Astronomy 132, we'll study our amazing, dynamic and varied Universe. We'll investigate our place in the Universe, and how we got here. We'll learn about the births, lives and spectacular deaths of stars. We'll consider familiar objects like our star (the Sun), more fantastic things like quasars, exploding supernovae and the expanding Universe, and things we cannot even see like supermassive black holes, dark matter and dark energy. Our studies will take us from the very small scale of subatomic particles to the largest scale of all: the primordial radiation that fills the Universe! Along the way we'll discover how the Universe began, how it is changing, and its final fate, and examine the ways astronomers piece together this wondrous puzzle.

Course Objectives

My goals in this course are to…

1. Convey the framework and basis of our understanding of the Universe.
2. Demonstrate that the Universe is dynamic and ever changing.
3. Establish that the Universe is knowable through the process of science and that physical laws are universal.
4. Build understanding of fundamental physical properties and phenomena.
5. Foster interest in astronomy and inspire ongoing study of science in general.

Expectations of the Professor

This is a university science course for non-science majors. The pre-requisites are high school algebra and geometry. You may have heard that there is "no math" in astronomy, but I can assure you that all university science courses use mathematics in our quest to understand the Universe! If you're rusty, don't worry, as we'll review the basics with you.

Time in the classroom is an essential part of this course, and it will be to your benefit to attend class meetings. Exams will be based on material discussed in class. This course is a collaborative effort – please ask questions, offer your opinions and ideas, and be prepared to participate in the discussion. Each class, there will be a few questions for you to vote on and consider with your neighbors. You'll want to be sure that you understand these questions, as they are sample exam questions. Be sure you can explain your understanding of these concepts and practice by discussing them with your neighbors in the time allotted during class! The University has put our class in an enormous classroom, so please sit in the first seven rows closest to the front of the room such that you have neighbors to talk to.

At UM, one "unit" represents three hours of work by the student. This is a three-unit course, so you can expect to put 9 hours of work into the course each week, including time in class. I strongly recommend that you complete the day's reading assignment before attending class. Please note that this is not a course in memorization! I am far more interested in you learning concepts rather than miscellaneous facts.

Exams will reflect this philosophy, generally asking you to reason out an answer based on evidence. This is, after all, what we do in science!

During our closed-book, closed-note exams, you must bring photo ID, you may not wear headphones, have a calculator, computer or a mobile phone, or communicate with anyone inside or outside the classroom except for the professor or exam proctors. Each student in this course is expected to work entirely on her/his own while taking any exam, to complete assignments on her/his own effort without the assistance of others unless directed otherwise by the professor.

An excerpt from the UM *Student Conduct Code*:

> Academic misconduct is defined as all forms of academic dishonesty, including but not limited to:
>
> 1. **Plagiarism:** Representing another person's words, ideas, data, or materials as one's own.
>
> 2. **Misconduct during an examination or academic exercise:** Copying from another student's paper, consulting unauthorized material, giving information to another student or collaborating with one or more students without authorization, or otherwise failing to abide by the University or instructor's rules governing the examination or academic exercise without the instructor's permission.
>
> 3. **Unauthorized possession of examination or other course materials:** Acquiring or possessing an examination or other course materials without authorization by the instructor.
>
> 4. **Tampering with course materials:** Destroying, hiding, or otherwise tampering with source materials, library materials, laboratory materials, computer system equipment or programs, or other course materials.

Plagiarism, cheating and other violations of the student conduct code will be taken seriously. A student in violation of the code will be assigned an F grade for the work in question and referred to the Office of the Vice President for Student Affairs for possible University sanctions. Please be aware of the behavior expected of UM students and do not put either of us in this position.

Class Attendance

Being actively involved in class activities will help you learn better. That is why I'm going to such effort to provide opportunities for you to engage! Your role in this class is to actively participate and take charge of your own learning. This means remembering to bring and use your vote card at every class meeting, answering questions and discussing questions with other students in class, and coming to office hours if you are struggling. My role as the instructor is to find ways to help you learn, show illustrative examples, ask you questions to find out what is confusing you, be available for and answer your questions, and provide lots of tools, feedback, and ways for you to assess your own learning.

Assigned Textbook & Online Homework System

This course does not have an assigned textbook. During the semester, I will post links to suggested (optional) readings on the course Moodle page. You may consider this material supplementary – homework and exams in the course will be based on material discussed in class.

We will be using an online homework system, the details of which will be discussed in class. Homework will typically be due at 5pm each Friday during the semester.

Course Etiquette

In order to maintain an orderly class environment that is conducive to learning, especially in this large classroom, all students must act with consideration. By remaining enrolled in this course, you agree to abide by all of the following policies:

- You will endeavor to arrive on time.
- You will not begin shuffling papers and packing belongings early. In a large class this creates a great deal of noise and chaos.
- You will discuss ideas aloud with your fellow students when asked to do so. At other times, please keep the volume low – in a large class side conversations can be disruptive.
- For the duration of class, keep your phone set to vibrate, silent or off.
- Use laptop computers only for note taking or not at all. Surfing the web is distracting to those around you, so please don't do it during class. If you really need to do email or do work for another class, stay home. Please do not come to class unless you will be participating.

IN RETURN, THE PROFESSOR AGREES TO:

- Start and end class on time. I will *never* keep you late, past the scheduled class end time of 10:50am. I will be respectful of your time.
- Give you frequent opportunities to discuss concepts with each other, and to ask questions in class.

Grading Policy

As you discussed on the first day, assessment in the course will be based on two midterm exams, a final exam, and weekly homework assignments. Your grade will be based on your performance as weighted below, based on your preferences from the first day. I have not chosen in advance how many As, Bs, etc to award – you will get the grade you earn regardless of the grades of others. I will set the letter grade breakdowns based on the performance of the class as a whole, rather than use rigid percentages.

Midterm Exams (2)	15% each
Cumulative Final Exam	30%
Homework	40%

There will not be any makeup exams. Midterm exams take place during regular class time on the scheduled days. If you cannot be present due to a university sponsored trip (e.g., research field work, athletics, class field trip) or religious observance, tell me *before* the exam and we can discuss arrangements. For *well-documented* compulsory absences, it may be possible for you to either take the exam *early* or have the exam replaced by the average of your other two exams. If you miss more than one exam, you will receive an Incomplete. There will be no opportunities to take the final exam at a different time, and in particular, no requests to take the final early will be approved. The final will be cumulative and your score may not be dropped.

Extra Credit

Extra credit may or may not be offered at the professor's discretion, as opportunities arise. These may include, but are not limited to: attending and writing about astronomy-related talks on or off campus, or writing papers about astronomy texts, or television or radio programs. Any extra credit opportunities will be offered to the whole class, and *not to individual students* – no need to ask! If any extra credit opportunities are offered (which is not guaranteed!), they will be both announced in class and available via the course Moodle page. No extra credit will be offered after the final exam.

Disability Policy

The University of Montana assures equal access to instruction through collaboration between students with disabilities, instructors, and Disability Services for Students (DSS). If you think you may have a disability affecting your academic performance, and you have not already registered with DSS, please contact DSS in Lommasson 154. I will work with you and DSS to provide an appropriate accommodation.

Course Schedule

Tu	Jan 24	Introductions
Th	Jan 26	The Night Sky: constellations & mythology
Tu	Jan 31	The Night Sky: motions and changes
Th	Feb 2	The Night Sky: planetarium visit
Tu	Feb 7	Gravity and orbits
Th	Feb 9	What's Out There? Light, Matter & Energy
Tu	Feb 14	Human Space Travel: history
Th	Feb 16	Human Space Travel: current and future
Tu	Feb 21	Tools of the Astronomer: the Telescope
Th	Feb 23	**Midterm Exam 1**
Tu	Feb 28	The life cycles of stars
Th	Mar 2	Types of stars
Tu	Mar 7	Evolved stars: red giants & white dwarfs
Th	Mar 9	Star death and supernovae
Tu	Mar 14	Exotic objects: neutron stars, magnetars, black holes
Th	Mar 16	Exoplanet detection and rogue planets
Tu	Mar 21	*Spring Break*
Th	Mar 23	
Tu	Mar 28	Project MINERVA: the search for habitable rocks
Th	Mar 30	Nebulae and galaxies: all the pretty colors
Tu	Apr 4	Galaxy formation and galactic cannibalism
Th	Apr 6	Quasars, supermassive black holes and our Galacic center
Tu	Apr 11	**Midterm Exam 2**
Th	Apr 13	Astrobiology, aliens and the Fermi Paradox
Tu	Apr 18	Dark Matter: where is everything?
Th	Apr 20	Light travel and lookback time: our expanding Universe
Tu	Apr 25	Formation of the Universe, cosmic background radiation
Th	Apr 27	The shape and death of the Universe
Tu	May 2	Dark Energy: where is everything going?
Th	May 4	String theory and multiverses
Mon	May 8	**Final Exam, 8:00am – 10:00am**

Suggested Reading Material

As noted above, this course does not have an assigned textbook. However, many students find it valuable to supplement the classroom experience with additional reading. Here I list textbooks that are suitable to the course, followed by some of the many excellent general audience books available on astronomy.

Textbooks, if you prefer

The Cosmic Perspective, by Bennett et al. (Pearson)

21st Century Astronomy, by Kay, Palen & Blumenthal (Norton)

The Cosmos: Astronomy in the New Millenium, by Pasachoff & Filippenko (Cambridge)

(Note: the first two books above have smaller editions labeled "stars and galaxies" which are less expensive and include most of the material in our course.)

Popular Science

NightWatch: A Practical Guide to Viewing the Universe, by Dickinson (stargazing in your backyard)

Bright Star Atlas, by Tirion (easy to use maps of the night sky)

The Stars: A New Way to See Them, by Rey (a constellation guide, more aimed at kids but a total classic)

A Student's Guide to the Mathematics of Astronomy, by Fleisch & Kregenow (a tutor in your pocket)

The Backyard Astronomer's Guide, by Dickinson (a guide to buying and using a small telescope)

The Right Stuff, by Wolfe (thrilling history of the beginning of US space flight)

A Man on the Moon, by Chaikin (compelling history of the Apollo lunar missions)

The Martian, by Weir (fictional, but the science is great – a look at human travel to Mars)

How I Killed Pluto and Why It Had It Coming, by Brown (a great look at how astronomers work)

How do You Find an Exoplanet?, by Johnson (an insider's guide to the techniques of planet hunting)

Cosmos, by Sagan (a classic book – and TV series – that launched the careers of many astronomers)

Welcome to the Universe, by Tyson, Strauss & Gott (a guided tour of the cosmos as of 2016)

Black Holes & Time Warps, by Thorne (a terrific book about exotic objects, worm holes, time travel)

Cosmic Catastrophes, by Wheeler (modern astronomy relating to gamma ray bursts, supernovae, etc.)

A Brief History of Time, by Hawking (cosmology and the history of the Universe, a classic book)

The Elegant Universe, by Greene (great summary of contemporary astrophysics, plus string theory)