

# AST 309R – Galaxies, Quasars, & The Universe

Fall 2020 – Unique No. 46585

MWF 11:00 AM – 12:00 PM

**Instructor:** Prof. Danielle A. Berg

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**Student Help Hour:** Mon 3:00 – 4:00 PM

## COURSE DETAILS

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**Course Meetings:** We will be meeting M, W, F 11:00 AM – 12:00 PM via zoom.

**Course Webpage:** Your main source of information will be the course webpage on Canvas. This is where you will find announcements, homework and reading assignments, grades, deadlines, be able to ask questions, and more. It is your responsibility to check the Canvas course page on a regular basis. Please come to class prepared, having done the assigned pre-class readings and assignments, and be ready to participate in discussions and activities.

**Course Materials:** In this class we will use digital content. You will need:

1. The Cosmic Perspectives (CP), 9<sup>th</sup> edition text
2. The Mastering Astronomy (MA) software.
3. The Proctorio proctoring plugin. You will need to have a Chrome browser for this.

CP and MA can be purchased separately or as a package:

Modified Mastering Astronomy with Pearson eText – Standalone Access Card

- o ISBN-13: 9780135208113

## COURSE DESCRIPTION

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How did the universe begin? How did the fiery gases of the Big Bang collect into “island universes” like our own Milky Way, even as the universe as a whole was expanding into the frigid emptiness of today? What processes led to the formation of stars, planets, and life? Where do we go from here?

This course presents modern observations and theories of the structure and evolution of the universe. Topics include the evidence for the Big Bang, the formation of galaxies, and the nature of bizarre stellar remnants such as black holes and quasars. We trace the evolution of the universe from the first moment through the creation of the primeval fireball radiation and the birth and evolution of galaxies. We examine the rich variety of observations of quasars, the evidence for giant black holes, the accelerating universe, dark matter, and dark energy.

The course is divided into four interlinking parts that will review what astronomers have learned about the stars, the galaxies, and the Universe. Part one includes the history of how astronomers developed the physical ideas we use as the foundational tools to study

and come to know things about distant objects throughout the cosmos. We will examine how astronomical ideas have been developed and tested against observations, and explore a few of the outstanding problems faced by current astronomical research. Part two will focus on the formation, life, and death of stars. Part three will expand to a view of our Galaxy and how galaxies in general form and evolve. Finally, we will look at the larger picture of how our Universe formed and evolved, and what major forces are responsible, including the role of Dark Matter and Dark Energy.

**Course Objectives:** By the end of this course, students should successfully be able to:

PART I – Developing an Astronomical Perspective:

- Understand the basic facts, principles, theories, and methods of modern science, and recognize that science is an evolving body of knowledge.
- Be able to outline our big-picture understanding of the cosmos, including the scale of space and time.
- Understand how the universality of key physics principles allow us to simultaneously explain the phenomenon of our everyday lives *and* the cosmos.
- Be able to describe the properties of light and how its interconnected nature with matter forms spectra, allowing astronomers to study the physical conditions in astronomical objects far away.
- Understand how telescopes work and how their technological advances are allowing the discovery of new astronomical phenomenon.

PART II – Stars and Stellar Life Cycles:

- Be able to describe the general properties of stars.
- Understand how the properties of stars are measured and how they are classified.
- Understand how stars form and how they evolve.
- Be able to describe how different stars end their lives as white dwarfs, neutron stars, or black holes, and why.

PART III – The Evolution of Galaxies and Cosmology:

- Be able to describe the history of our Milky Way.
- Understand the recycling process of stars and gas and how it shapes galaxies.
- Understand how properties of galaxies are measured, including distances & velocities.
- Be able describe how the study of galaxies and their evolution form the foundation of modern cosmology.

PART IV – The Formation and Evolution of the Universe

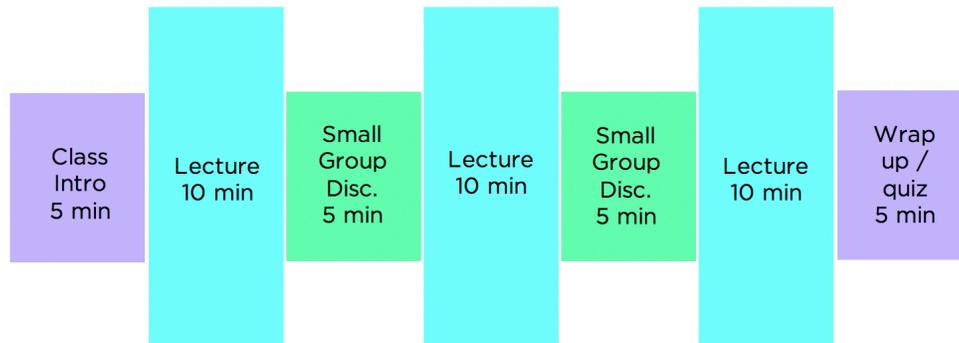
- Be able to describe the Big Bang model of the Universe.
- Understand the evidence that supports our current cosmological model, including what the cosmic microwave background is.
- Be able to describe what Dark Matter and Dark Energy are.
- Understand the geometry of space, expansion of the Universe, and the role of gravity.
- Be able to describe the ultimate fate of the universe.

## COURSE STRUCTURE

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Each week during our scheduled course times (M,W,F 11 AM – 12 PM), there will be 3 x 1-hour online meetings that will include lectures, discussions, quizzes, and group activities. There will also be daily reading and/or homework assignments that are designed to aid your comprehension and explore some of the course topics in greater depth. There will be four comprehension exams, one for each part of the class. There will be no final.

In a typical week, two classes will be lecture/discussion-based class and one will be an activity-based class. Each lecture/discussion-based class will be broken down into smaller 5-10 minute segments. You can expect something like this:



**Course Communication:** For this course, all of our interactions will be virtual, so here are some guidelines to help make sure we keep up good communication and that our interactions are enjoyable:

- **Questions:** I'm always happy to take questions during lecture; please use the 'raise hand' feature in Zoom so that I can see that you have a question. For questions outside of class, please post to the Canvas discussion board for our class.
- **Microphone:** Please ensure that your microphone is working before class. You will be working with other students in breakout rooms during lecture periods and conversing with your classmates will be an important part of the experience.
- **Announcements:** I will regularly post information using Canvas announcements. Please check your notifications settings in Canvas to ensure that you are receiving the email versions of those announcements frequently.
- **Environment:** I am committed to providing you with a friendly, productive, and effective learning. There are things that you can do to help with this:
  1. Use video and Zoom backgrounds if your device allows. Backgrounds for this class must be astronomy-themed and appropriate. If I ask you to change your background, you must do so immediately.
  2. Mute your audio whenever you are not speaking.
  3. Use the raise hand button to ask a question even if you put the question in the chat.
  4. Please refrain from using the chat for comments not related to the class.
  5. Silence your phone and email notifications so that they don't interrupt you while you are speaking.

**Course Participation:** Class participation is required. Here is what you can expect:

- You will need to participate during class in Zoom polls, small group discussions and activities, end of class quizzes, etc.
- You should be ready to speak and be seen, at least by your small group, during class meetings.
- Try to be fully present when logged into class - this means shutting down other webpages and apps.
- Online learning can also be exhausting, so if you need to take a short break or stand up, please do so!

## COURSE GRADING

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Course grade will be evaluated on three components:

1. Homework – constitutes 40%
2. Exams – constitute 40%
3. In-class participation – constitutes 20%

**Grading Scale:** The grading scale is below. Note that this course will *not* be graded on a curve. Your grade is calculated to the nearest 1/100<sup>th</sup> of a percentage point.

<b>A:</b> 94.00 – 100%	<b>B–:</b> 79.00 – 82.99%	<b>D+:</b> 67.00 – 70.99%
<b>A–:</b> 91.00 – 93.99%	<b>C+:</b> 76.00 – 78.99%	<b>D:</b> 63.00 – 66.99%
<b>B+:</b> 87.00 – 90.99%	<b>C:</b> 73.00 – 75.99%	<b>D–:</b> 60.00 – 62.99%
<b>B:</b> 83.00 – 86.99%	<b>C–:</b> 70.00 – 72.99%	<b>F:</b> 0.00 – 59.99%

**Course Participation:** Class attendance and participation is required during the scheduled online class times. During each class time, Zoom will record the *duration* that you are online, and you will receive credit for being present during class for 40 minutes or more. Class participation credit participation makes up **20%** of your grade. This is to ensure that you learn and benefit from the in-class activities, discussions, and quizzes. Short quizzes will be given at the end of each class for participation points only. These quizzes will help me assess the overall comprehension of that day's topic. You can miss up to 3 classes without penalty (the 3 days with the lowest scores will be dropped from your average), but no makeup participation points will be allowed.

**Homework:** There will be daily online reading and homework assignments, each of which has a low weight, but all together will make up **40%** of your grade. They will be due by the start (11:00 AM) of each class that they are assigned (see schedule below or week plan on CANVAS) and will be available to you one week prior to their due date. Homework assignments will done in the online **Mastering Astronomy** portal; they can be found directly in Mastering Astronomy or via the assignment links in canvas, which will take you to Mastering Astronomy. Late homework will not be accepted.

**Exams:** There will be 4 x 1-hour exams throughout the semester. Each exam will count for **10%** of your grade, or **40%** all together. Exams will occur during the scheduled class time using the proctoring service **Proctorio**. The plugin for Proctorio will need to be installed into you chrome browser. There will be no makeup exams.

## COURSE POLICIES

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**Communication Policy:** Please email me at any time for questions of a personal nature. For questions about class content or logistics you **must** post the question to the canvas discussion board or ask it during student help hours. If no one responds to your post within 24 hours, or the TA is unable to answer your question, you may email me, including a link to the discussion post or a screenshot of the TA's response.

**Homework and Exams:** No late or makeup work / exams will be accepted.

**Exceptions:** Late and makeup work / exams will not be accepted. However, I understand that unpredictable life events happen, so exceptions may be made for special circumstances. If you are unable to submit homework on time or attend an exam, you must contact me in advance of the due date for your exception to be considered. If you experience a personal or family emergency (death in the family, protracted sickness, serious mental health issues) that prevents you from attending an exam or forces you to miss multiple days of class, you should contact [Student Emergency Services in the Office of the Dean of Students](#). They will work with you to communicate with your professors and let them know of your situation.

**Accommodations for family responsibilities:** I recognize the difficulty of being a full time student with children, *especially* during this pandemic. If you have children, or other family commitments that may interfere with your work, please email me to discuss any modifications of the course policies that will help maximize your success in this course.

**Accommodations for Religious Holidays:** A student who is absent from a class or examination for the observance of a religious holiday will be permitted to make up the missed work, if notice is given at least fourteen days prior to such an absence.

**Accommodations for disabilities:** If you have any kind of disability, whether apparent or non-apparent, learning, emotional, physical, or cognitive, please feel free to contact me to discuss reasonable accommodations for your access needs. Students with disabilities may also request appropriate accommodations from the university: The University of Austin provides upon request appropriate academic accommodations for qualified students with disabilities. For more information, contact the Office of the Dean of Students (471-6259, 471-6441 TTY) or [Division of Diversity and Community Engagement, Services for Students with Disabilities](#) (512-471-6259).

**Zero-tolerance of harassment/assault:** Harassment of any sort will not be tolerated in this class or related workspaces. Title IX and Title VII makes clear that violence and harassment based on sex, gender, race, or national origin are Civil Rights violations subject to investigation and disciplinary action on behalf of the University. The same kinds of accountability and support will be applied to offenses against other categories such as sexual orientation and gender identity. If you or someone you know has been harassed or assaulted, either in the classroom or outside of the classroom space, you can find the appropriate resources through the University Title IX Coordinator (512-232-3992), UT Austin Campus Police (512-471-4441), the Student Ombuds Services (which can provide *confidential* advice, resources and help; 512-471-3825), and the UT Counseling and Mental Health Center (512-471-3515).

**Mental Health Services:** College life can be challenging and stressful; **the uniqueness of the COVID-19 outbreak is especially stressful. Your first priority should be taking care of yourself and your own health, and those around you. If you experience diminished mental health, please seek help.** Diminished mental health, including significant stress, mood changes, excessive worry, or problems with eating and/or sleeping can interfere with optimal academic performance. Similarly, problems with relationships, family worries, loss, or a personal struggle or crisis can also contribute to decreased academic performance. [UT Austin's Counseling and Mental Health Center](#) (512-471-3515) provides mental health services to support the academic success of students. This includes counseling services, wellness workshops, free and confidential therapy groups, and general information. I encourage you to browse their website and actively seek support if you're experiencing any of these difficulties.

**Expectations regarding mutual respect:** Astronomy belongs to all people, independent of race, religion, gender, gender identity, gender expression, or sexual orientation. Incidents of discrimination, assault, harassment, threats, intimidation, profiling, or coercion based on membership or perceived membership will not be tolerated. Show each other respect no matter perceived knowledge or performance in this class, or any other.

**Academic Dishonesty:** The minimum penalty for cheating — in any way whatsoever — is receiving a zero on the assignment on which you cheated. The instructor reserves the right to seek a penalty the instructor deems appropriate for the given case of academic dishonesty, including failing the class and being reported to Student Judicial Services. If the academic honesty is sufficiently serious, the instructor will proceed by filing a formal report to the Judicial Services in the Dean of Students Office as is policy. Judicial Services would decide the final penalty after a hearing on the matter. For more information, read in the General Information Catalog about scholastic dishonesty.

**Sharing of Course Materials is Prohibited:** No materials used in this class, including, but not limited to, lecture hand-outs, videos, assessments (quizzes, exams, papers, projects, homework assignments), in-class materials, review sheets, and additional problem sets, may be shared online or with anyone outside of the class unless you have my explicit, written permission. Unauthorized sharing of materials promotes cheating. It is a violation of the University's Student Honor Code and an act of academic dishonesty. I am well aware of the sites used for sharing materials, and any materials found online that are associated with you, or any suspected unauthorized sharing of materials, will be reported to Student Conduct and Academic Integrity in the Office of the Dean of Students. These reports can result in sanctions, including failure in the course.

**Class Recordings:** Class recordings are reserved only for students in this class for educational purposes and are protected under FERPA. The recordings should not be shared outside the class in any form. Violation of this restriction by a student could lead to Student Misconduct proceedings.

## COURSE SCHEDULE

CLASS #	DATE	TOPIC	MA DUE PRECLASS	READING DUE PRECLASS
1	W Aug 26 <sup>th</sup>	Introduction	--	--
2	F Aug 28 <sup>th</sup>	The Science of Astronomy	<ul style="list-style-type: none"> <li>• Intro to MA</li> <li>• Syllabus quiz</li> </ul>	<ul style="list-style-type: none"> <li>• Syllabus</li> <li>• CP 3.1 &amp; 3.1</li> </ul>
3	M Aug 31 <sup>st</sup>	The Science of Astronomy	<ul style="list-style-type: none"> <li>• TBD</li> <li>• lalla</li> </ul>	<ul style="list-style-type: none"> <li>• CP 3.3 &amp; 3.4</li> </ul>
4	W Sept 2 <sup>nd</sup>	A Modern View of The Universe	<ul style="list-style-type: none"> <li>• TBD</li> </ul>	<ul style="list-style-type: none"> <li>• CP 1.1 &amp; 1.2</li> </ul>
5	F Sept 4 <sup>th</sup>	A Modern View of The Universe	<ul style="list-style-type: none"> <li>• TBD</li> </ul>	<ul style="list-style-type: none"> <li>• CP 1.3 &amp; 1.4</li> </ul>
NA	M Sept 7 <sup>th</sup>	--	--	--
6	W Sept 9 <sup>th</sup>	Motion, Energy, & Gravity	<ul style="list-style-type: none"> <li>• TBD</li> </ul>	<ul style="list-style-type: none"> <li>• CP 4.1—4.3</li> </ul>
7	F Sept 11 <sup>th</sup>	Motion, Energy, & Gravity	<ul style="list-style-type: none"> <li>• TBD</li> </ul>	<ul style="list-style-type: none"> <li>• CP 4.4 &amp; 4.5</li> </ul>
8	M Sept 14 <sup>th</sup>	Light and Matter	<ul style="list-style-type: none"> <li>• TBD</li> </ul>	<ul style="list-style-type: none"> <li>• CP 5.1 &amp; 5.2</li> </ul>
9	W Sept 16 <sup>th</sup>	Light and Matter	<ul style="list-style-type: none"> <li>• TBD</li> </ul>	<ul style="list-style-type: none"> <li>• CP 5.3 &amp; 5.4</li> </ul>
10	F Sept 18 <sup>th</sup>	Telescopes	<ul style="list-style-type: none"> <li>• TBD</li> </ul>	<ul style="list-style-type: none"> <li>• CP 6.1 &amp; 6.2</li> </ul>
11	M Sept 21 <sup>st</sup>	Telescopes	<ul style="list-style-type: none"> <li>• TBD</li> </ul>	<ul style="list-style-type: none"> <li>• CP 6.3 &amp; 6.4</li> </ul>
12	W Sept 23 <sup>rd</sup>	Exam 1 Review & Practice	<ul style="list-style-type: none"> <li>• TBD</li> </ul>	--
13	F Sept 25 <sup>th</sup>	EXAM 1 Ch 1-6	--	--
14	M Sept 28 <sup>th</sup>	Space and Time	<ul style="list-style-type: none"> <li>• TBD</li> </ul>	<ul style="list-style-type: none"> <li>• CP S2.1 &amp; S2.3</li> </ul>
15	W Sept 30 <sup>th</sup>	Spacetime and Gravity	<ul style="list-style-type: none"> <li>• TBD</li> </ul>	<ul style="list-style-type: none"> <li>• CP S2.4, S3.1, &amp; S3.2</li> </ul>
16	F Oct 2 <sup>nd</sup>	Spacetime and Gravity	<ul style="list-style-type: none"> <li>• TBD</li> </ul>	<ul style="list-style-type: none"> <li>• CP S3.3—S3.6</li> </ul>
17	M Oct 5 <sup>th</sup>	Star Stuff	<ul style="list-style-type: none"> <li>• TBD</li> </ul>	<ul style="list-style-type: none"> <li>• CP 17.1 &amp; 17.2</li> </ul>
18	W Oct 7 <sup>th</sup>	Star Stuff	<ul style="list-style-type: none"> <li>• TBD</li> </ul>	<ul style="list-style-type: none"> <li>• CP 17.3 &amp; 17.4</li> </ul>
19	F Oct 9 <sup>th</sup>	Star Stuff	<ul style="list-style-type: none"> <li>• TBD</li> </ul>	<ul style="list-style-type: none"> <li>• TBD</li> </ul>
20	M Oct 12 <sup>th</sup>	The Bizarre Stellar Graveyard	<ul style="list-style-type: none"> <li>• TBD</li> </ul>	<ul style="list-style-type: none"> <li>• CP 18.1—18.3</li> </ul>
21	W Oct 14 <sup>th</sup>	The Bizarre Stellar Graveyard	<ul style="list-style-type: none"> <li>• TBD</li> </ul>	<ul style="list-style-type: none"> <li>• CP 18.4</li> </ul>

22	F Oct 16 <sup>th</sup>	EXAM 2 Ch S2, S3, 17, 18	--	--
23	M Oct 19 <sup>th</sup>	Our Galaxy	• TBD	• CP 19.1 & 19.2
24	W Oct 21 <sup>st</sup>	Our Galaxy	• TBD	• TBD
25	F Oct 23 <sup>rd</sup>	Our Galaxy	• TBD	• CP 19.3 & 19.4
26	M Oct 26 <sup>th</sup>	Galaxies and The Foundation of Modern Cosmology	• TBD	• CP 20.1 & 20.2
27	W Oct 28 <sup>th</sup>	Galaxies and The Foundation of Modern Cosmology	• TBD	• TBD
28	F Oct 30 <sup>th</sup>	Galaxies and The Foundation of Modern Cosmology	• TBD	• CP 20.3 & 20.4
29	M Nov 2 <sup>nd</sup>	Galaxy Evolution	• TBD	• CP 21.1 & 21.2
30	W Nov 4 <sup>th</sup>	Galaxy Evolution	• TBD	• CP 21.3 & 21.4
31	F Nov 6 <sup>th</sup>	Galaxy Evolution	• TBD	• TBD
32	M Nov 9 <sup>th</sup>	EXAM 3 Ch 19 - 21	--	--
33	W Nov 11 <sup>th</sup>	The Birth of The Universe	• TBD	• CP 22.1 & 22.2
34	F Nov 13 <sup>th</sup>	The Birth of The Universe	• TBD	• CP 22.3 & 22.4
35	M Nov 16 <sup>th</sup>	Dark Matter & Dark Energy	• TBD	• CP 23.1 & 23.2
36	W Nov 18 <sup>th</sup>	Dark Matter & Dark Energy	• TBD	• CP 23.3 & 23.4
37	F Nov 20 <sup>th</sup>	Dark Matter & Dark Energy	• TBD	• TBD
38	M Nov 23 <sup>rd</sup>	Exam 4 Review	• TBD	• TBD
39	M Nov 30 <sup>th</sup>	EXAM 4	--	--
40	W Dec 2 <sup>nd</sup>	Special Topics	• TBD	• TBD
41	F Dec 4 <sup>th</sup>	Special Topics	• TBD	• TBD
42	M Dec 7 <sup>th</sup>	Special Topics	• TBD	• TBD