

# PHYSICS 1505 - INTRODUCTORY ASTRONOMY

## Spring 2025

<https://umsystem.instructure.com/courses/285884>

### Description

An introductory course in basic astronomy designed primarily for students other than those in science and engineering. Topics include history, the sky, the solar system, stars, stellar evolution, galaxies and the origin and evolution of the universe.

### Instructor

**Professor Marco Cavaglia** [he/him]

Office: Physics 204

Office hours: Wednesday 12:00 p.m. – 1:00 p.m. or by appointment. Please confirm beforehand for availability.

Email: [cavagliam@mst.edu](mailto:cavagliam@mst.edu)

Please address your instructor with his academic title when emailing him. **Emails that do not include a proper salutation or sign-off will not be responded to.** Your instructor will answer to your emails as quickly as possible, but please keep in mind that teaching this course is only one of his many responsibilities. Please be patient with him. If you have not received a response within one working day, don't hesitate to send a reminder.

### Meeting time and location

**Lectures:** Monday, Wednesday, and Friday 3:00 p.m. – 3:50 p.m. in Physics 104.

## Textbook (required)

J.O. Bennett, M.O. Donahue, N. Schneider, and M. Voit,  
*Cosmic Perspective Fundamentals, The, 3rd edition*,  
Pearson (January 4, 2019),  
url: <https://tinyurl.com/p8j7xa7z>



## Course goals and student learning outcomes

Upon completing this course, the successful student will have a good understanding of the basics concepts of modern astrophysics.

## Evaluation

**Exams.** There will be two midterm exams on Friday, February 28th, and Friday, April 18th, during class time. The final exam will be on Friday, May 16th, from 10:00 a.m. to 12:00 p.m. The first midterm exam will cover the course material from Wednesday, January 22nd, through Monday, February 24th (inclusive). The second midterm exam will cover the course material from Monday, March 3rd, through Monday, April 14th (inclusive). **The final exam will be in two sections. Section (a) is mandatory.** It will cover the material from Monday, April 21st, to Wednesday, May 9th. **Section (b) is optional.** It will cover the material of the two mid-term exams. If you choose to take it and score better than in any of the mid-term exams, its score will replace the lowest of the two mid-term exam scores.

The exams will consist of a set of multiple-choice questions and two simple problems to be worked out. You will be allowed to use a calculator and will be provided with an equation sheet by the instructor. **No use of notes or books will be allowed.** If you miss an exam because of a civil duty (e.g., jury duty or military service), official university competitions, performances, or travel, religious observations, or certain scheduled medical procedures, they should inform the instructor ahead of time to arrange an accommodation. **Missing an exam without prior notification of the instructor will lead to receiving a zero.** However, illnesses and other problems, which sometimes occur unexpectedly, may lead to an accommodation in this policy.

**Homework.** There will be 11 assignments over the course of the semester, each worth 50 points. They consist of four multiple-choice questions (worth 5 points each) and two problems (worth 15 points each). The 10 best scores will count toward the final grade, i.e., the lowest score will be dropped. Assignments will be announced in class and must be uploaded in canvas before the date and time they are due. **Late submissions will not be allowed.** However, if there is a valid reason (e.g., due to documented illness), you may be excused from turning in an assignment on time. If you have extended unavoidable absences, the instructor may make some adjustments to the homework policy. Requests for regrades must be submitted before the end of the first class after graded assignments are returned.

**Assignments must be easy to read on a computer screen. Please:** No writing so small that it requires a large zoom factor to see; no writing that crosses lines, jumps up and down, and/or makes a maze on the page. Symbols and English words should be easily readable. If you have forgotten how to write in proper calligraphy, please type the assignment. **Messy assignments will not be graded.**

**Show all your work: the answer alone is not worth anything.** Solutions must be explained in enough text to be understandable. Numerical answers should have units and a proper number of significant digits. You should keep all returned assignments until the final grade of the course has been posted by the instructor. **Transgression of the above rules will reduce your grade on the assignment.**

**Note regarding the usage of artificial intelligence (AI) and other cheating techniques.** Your instructor knows how tempting it is to cheat on assignments by using AI, the natural intelligence of your classmates, or other in-person or online techniques. *“The fear of loss is a path to the dark side.”* However, keep in mind that: (1) AI is not as intelligent as you believe it is; (2) Based on the content of your assignment, your instructor can readily establish whether you cheated. If you think you outwit him because he does not say anything to you, it is because he knows you will pay the price for cheating later, when you will be unprepared for the exams; (3) **Your instructor strongly encourages you to work out assignments by yourself**, using only your mental capabilities; (4) If you do not, you’ll most likely score poorly on in-class tests and the final exam, where your only tool will be your brain trained on what you learned. There is an elevated risk that you will fail or receive a bad grade. *“Once you start down the dark path, forever will it dominate your destiny.”*

## Grading

Grade points will be based on assignments and exams as follows:

<b>Homework</b>	500
<b>First mid-term exam</b>	200
<b>Second mid-term exam</b>	200
<b>Final exam (section a)</b>	100
<b>Final exam (section b)</b>	200 <sup>(*)</sup>
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<b>Total</b>	1000

(\*) If the score is higher than any of the mid-term exam scores, it replaces the lowest mid-term exam score. Otherwise, it counts as zero.

## Grading scale (points):

<b>A:</b>	895 and above
<b>B:</b>	795 – 894
<b>C:</b>	695 – 794
<b>D:</b>	595 – 694
<b>F:</b>	594 and below

## Course attendance policy

**This course is Classroom Based. You are required to attend all classes.** Please do not arrive late to class or leave early unless you have been previously excused by the instructor. Of course, if you are taken ill during class or in case of an emergency, feel free to leave. However, as soon as you feel better or the emergency is over, let the instructor know why you left. The instructor will not solicit details of the occurrence or any personal or private information.

Students with inadequate attendance may be dropped. Any student who has inadequate attendance, as evidenced by five confirmed absences or missing a total of five graded assignments of any kind (exams and/or homework), is subject to being dropped if a subsequent class or assignment is missed.

The university requires that all students have their course attendance verified at least once during the first two weeks of the semester. If your attendance is not verified, you will be dropped from the course, and any financial aid will be adjusted accordingly.

## Health and well-being

**In this course, the physical and mental well-being of all students (as well as the instructor) takes precedence over all other considerations.** The instructor will strive to keep the students safe and healthy. Your instructor hopes students will do the same for their well-being as well as the instructor's well-being. While no situation is risk-free, there are easy and effective actions you can take to protect yourself and others around you.

**If you're feeling unwell, stay at home.** Staying at home until you feel better or have been cleared to return to campus by health officers reduces the risk that you will pass on an illness to your friends, fellow students, your instructor, and others in your community. It will help ensure a smooth educational experience over the semester, as well as reduce the burden on our health services. Please contact Student Health Services at [mstshs@mst.edu](mailto:mstshs@mst.edu)

and/or 573-341-4284, if you become ill or are unable to attend class or take tests on campus.

**Bugs.** To protect our campus community and each other from the risks of viral infections, Missouri S&T strongly encourages all students, faculty, and staff to be up-to-date on vaccinations. A combination of vaccination, staying home when you are sick, and seeking testing when you have symptoms will be our most effective measures to mitigate against the spread of viruses. There is no requirement to provide proof of immunization, but voluntary reporting of vaccination information can be done at <https://studenthealth.mst.edu/>. If you are isolating, you will receive an absence note from Student Health and not Student Support and Community Standards (Care Management). You will be responsible of forwarding the absence note to the instructor.

**In the event of instructor or campus emergency the course will continue online on the zoom platform.**

## **Copyright, FERPA, and use of electronic devices during class**

**It is vitally important that our classroom environment promote the respectful exchange of ideas.** This entails being sensitive to the views and beliefs expressed during discussions, whether in class or online. Please obtain instructor permission before recording any class activity. It is a violation of University of Missouri policy to distribute such recordings without authorization and the permission of all who are recorded. More information is provided [online](#).

**Note on the use of internet-enabled devices in the classroom.** Your instructor's main goal in this class is to provide the best possible teaching experience. This includes mutual respect as well as cooperation among all parties (instructor and students). Students that search the internet, chat with friends, or watch TikTok videos about topics unrelated to the course while in class are examples of disrespectful student behavior. **Students who use personal electronic devices in the classroom for non-class work will be asked to stop, unless there is an emergency. Students will be asked to leave if they do not comply. In the event of refusal, the behavior will be considered disruptive, and your instructor and lab assistant reserve the right to request that an appropriate disciplinary action be taken by the Campus Judicial Officer.**

## **Accessibility and accommodations**

It is the university's goal that learning experiences be as accessible as possible. Student Accessibility and Testing provides services and accommodations that facilitate full participation in Missouri S&T's learning experience for students with disabilities. If you anticipate or experience physical, academic, and/or digital barriers due to a disability, please

contact Student Accessibility and Testing at (573) 341-6655, email [dss@mst.edu](mailto:dss@mst.edu), or visit <https://saat.mst.edu/> for information.

## Academic integrity and disruptive behavior

All students are expected to follow the [Standard of Conduct](#) and [Honor Code](#). **Academic dishonesty and disruptive behavior will not be tolerated** and will be dealt with in accordance with university policies.

[Student Academic Regulations](#) describes the student standard of conduct relative to the University of Missouri System's Collected Rules and Regulations section 200.010, and offers descriptions of academic dishonesty including cheating, plagiarism, sabotage, and unauthorized use of artificially generated content, any of which will be reported to the Dean of Students. You should familiarize yourselves with the Student Conduct Rules of the University of Missouri in [Section 200.010](#) of the [Collected Rules and Regulations](#) to review the expected standards for student academic integrity, disciplinary procedures, sanctions, and appeal procedures. Other resources for students regarding academic integrity can be found at this [link](#).

**In the event of disruptive behavior, the course instructor will request the campus Judicial Officer to take effective disciplinary action after issuing a warning.** See Student Academic Regulations at <http://registrar.mst.edu/academicregs>.

## Disability policy

The Americans with Disabilities Act prohibits discrimination against and guarantees that people with disabilities have the same opportunities as people without a disability. Missouri S&T and your instructor are committed to providing educational opportunities for all academically qualified students. Reasonable accommodations to ensure equitable access to its programs and services for individuals with disabilities will be made in compliance with the Americans with Disabilities Act.

At the beginning of the semester, students with disabilities who have had their status verified by the Office of Student Disability Services should get in touch with the instructor to go over their specific accommodation requirements.

To learn more about student disability services available to Missouri S&T students, please visit <https://dss.mst.edu/>.

## Non-discrimination, equity and Title IX

Missouri S&T is committed to the safety and well-being of our campus community, and to creating an environment free from discrimination and harassment.

The University prohibits discrimination and harassment on the basis of race, color, national origin, ancestry, religion, sex, pregnancy, sexual orientation, gender identity, gender expression, age, disability, protected veteran status, and any other status protected by applicable state or federal law. As used in this policy, the word “sex” is also inclusive of the term “gender.”

Additionally, US Federal Law Title IX states that no member of the university community shall, on the basis of sex, be excluded from participation in, or be denied benefits of, or be subjected to discrimination under any education program or activity. Sexual harassment violations of this law include quid pro quo, hostile environment, sexual assault, dating/domestic violence, and stalking. The U.S. Department of Education has stated the prohibition on discrimination on the basis of sex includes sexual orientation and gender identity.

Students who are experiencing pregnancy or pregnancy-related conditions, including the birthing parent and non-birthing parent, have rights protected under Title IX. Students should contact Student Accessibility and Testing or the Office of Equity and Title IX to learn more about their rights and pregnancy-related assistance/accommodations provided by the University to ensure equitable access to University educational programs and activities.

In accordance with the University of Missouri’s Collected Rules and Regulations, all faculty and staff are required to report any information concerning discrimination disclosed through communication including, but not limited to, direct conversation, email, social media, classroom papers and homework exercises to the Equity Officer/Title IX Coordinator.

For more information regarding support for those that have been impacted or to report an incident of discrimination or harassment as defined by [Chapter 600](#) of the University’s Collected Rules and Regulations, visit the Office of Equity and Title IX or visit their website at [equity.mst.edu](http://equity.mst.edu).

### **Office of Equity and Title IX**

Equity Officer and Title IX Coordinator: Dr. Paul Hirtz

Phone: (573) 341-7734

Location: 900 Innovation Drive, Suite 500

E-mail: [equity@mst.edu](mailto:equity@mst.edu)

## **Changes to this syllabus**

If a revision of the syllabus becomes necessary during the semester, it will be discussed in class.

# Statement of agreement

Please carefully review and print for your records this syllabus. **By taking this class, you confirm that you have read and understood this document and are agreeable to the policies and provisions set forth therein.**

## Appendix A: Other resources

S&T provides resources to support your mental, physical, and social well-being. Any of us can experience challenges that make learning difficult. If you are struggling, take advantage of the following resources offered by the university.

**Student Well-Being** provides counseling services, health promotion initiatives, and prevention programs to empower the S&T community to thrive and enhance personal, academic, and professional success. Department office hours are Monday – Friday, 8 a.m. – 4:30 p.m. On the website, you can find information related to confidential individual and group counseling, wellness consultations and trainings, case management services, resources for many health and wellness topics, and help for mental health crisis situations. For the 988 Suicide and Crisis Lifeline, call or text 988, or visit [missouri988.org](https://missouri988.org).

The **Health and Well-Being Canvas Course** features trainings, presentations, and other health and well-being resources for students. The course is free for all students, is non-credit, and students can enroll at any point in the semester.

**Student Support and Community Standards** is your central resource for support. During your time at S&T, you or a friend may need help navigating their student experience, facing a barrier, or experiencing a challenge. You are not alone! Student Support has a dedicated team and numerous resources such as **UCARE** and the **student emergency fund** to help you navigate the S&T experience and support your success. This includes support to address barriers related to academic, personal, emotional, medical, financial, or any other needs. All students can learn and grow from challenges or setbacks, they are stepping stones to success and we are here to help.

The **Curtis Laws Wilson Library** is the place to gather on campus, offering group meeting spaces, quiet study carrels and reservable conference rooms. The library provides students and faculty with physical and electronic books, journals, articles and databases as well as recreational reading, games and DVDs. We also have technology to check out, from laptops to chargers to calculators and everything inbetween. Librarians create library and course guides to help navigate searching for resources. Talk to us one-on-one via chat, email, phone or in person for any assistance regarding library services or finding peer-reviewed, credible research materials for study and research needs. Find out more information and connect with the library at this link: <https://library.mst.edu>.

The **Writing and Communication Center**'s mission is to assist all students in their



efforts to become better writers, communicators, and critical thinkers. The Center's peer consultants and coaches provide free individualized one-on-one and small group conversations to offer meaningful feedback and guidance to students across all disciplines. More information can be found on our website, through email: [writing@mst.edu](mailto:writing@mst.edu) or stop by Curtis Laws Wilson Library 314-315.

The **Student Success Center** (SSC) offers peer tutoring and success coaching to help students succeed in their academic goals. Additionally, we work as a resource hub and can connect you to the campus resources necessary to help you dig deeper and finish the semester strong. Visit the SSC in Room 117 Innovation Lab and contact us at [ssc@mst.edu](mailto:ssc@mst.edu) or 573-341-7590. To learn more about the SSC, visit <https://ssc.mst.edu>. SSC helps in three ways:

- The **LEAD Drop-in** service provides convenient access to experienced peer learning assistants for a multitude of courses across campus. No appointments necessary. Simply check the tutoring schedule to discover when support for your specific course is available at <https://ssc.mst.edu/leaddrop-in>.
- The **LEAD Group Sessions** offer after-hours group tutoring, facilitated by dedicated peer learning assistants in partnership with faculty members. Explore the LEAD Group schedule to see if your course is featured and join LEAD at the next session: <https://ssc.mst.edu/leadgroup>.
- If your schedule clashes with our LEAD offerings, or if your course isn't covered, **Knack Tutoring** is your solution. Request a tutor for either a virtual meeting or an in-person session on campus, ensuring you get the help you need, when you need it. To sign up for your FREE Knack account, visit <https://ssc.mst.edu/knacktutoring>.

The **Military & Veterans Resource Center** (MVRC) is dedicated to supporting those who have served, are currently serving, and those who aspire to serve in our nation's armed forces, along with their families. We are committed to fostering a welcoming and inclusive environment that empowers military-connected students to achieve their educational and personal goals. Through tailored resources, academic and career support, and community connections, we aim to enhance the success and well-being of service members, veterans, and their loved ones as they transition into and thrive within higher education here on campus.

## Assignment schedule

	Lectures	Opens (Friday)	Due (Wednesday)
<b>Assignment 1</b>	January 22, January 24	January 24	<b>January 29</b>
<b>Assignment 2</b>	January 27, January 29 January 31	January 31	<b>February 5</b>
<b>Assignment 3</b>	February 3, February 5 February 7	February 7	<b>February 12</b>
<b>Assignment 4</b>	February 10, February 12 February 14	February 14	<b>February 19</b>
<b>Assignment 5</b>	February 17, February 19 February 21	February 21	<b>February 26</b>
<b>Assignment 6</b>	February 24, March 3 March 5, March 7	March 7	<b>March 12</b>
<b>Assignment 7</b>	March 10, March 12 March 17, March 19 March 21	March 21	<b>April 2</b>
<b>Assignment 8</b>	March 31, April 2 April 4	April 4	<b>April 9</b>
<b>Assignment 9</b>	April 7, April 9 April 11	April 11	<b>April 16</b>
<b>Assignment 10</b>	April 14, April 21 April 23, April 25	April 25	<b>April 30</b>
<b>Assignment 11</b>	April 28, April 30 May 2	May 2	<b>May 7</b>

**Part I: The solar system** (Roughly Chapters 1-6, January 22 through February 28. Section numbers are approximate.)

	<b>Monday</b>	<b>Wednesday</b>	<b>Friday</b>
<b>Week 1</b>		<b>January 22</b> Introduction. The scale of the universe. [1.1]	<b>January 24</b> The age and the history of the universe. [1.2,4.3]
<b>Week 2</b>	<b>January 27</b> Earth's seasons. [2.1]	<b>January 29</b> The Moon. Eclipses. [2.2]	<b>January 31</b> Planetary motion. Solar system models. [1.3,3.1]
<b>Week 3</b>	<b>February 3</b> Star distances. Parallax. [2.3,12.1]	<b>February 5</b> What is science? [3.2,3.3]	<b>February 7</b> Light and telescopes. [3.1,5.1]
<b>Week 4</b>	<b>February 10</b> The solar system. [4.1]	<b>February 12</b> The terrestrial planets. [5.1]	<b>February 14</b> Evolution and comparison of terrestrial planets. [5.2,5.3]
<b>Week 5</b>	<b>February 17</b> The gas planets [6.1]	<b>February 19</b> The small bodies of the solar system [6.2]	<b>February 21</b> Search for life in the solar system [15.1]
<b>Week 6</b>	<b>February 24</b> The formation of the solar system. [4.2]	<b>February 26</b> First midterm review.	<b>February 28</b> First midterm exam.

**Part II: Stars** (Roughly chapters 7-11, March 3 through April 18. Section numbers are approximate.)

	<b>Monday</b>	<b>Wednesday</b>	<b>Friday</b>
<b>Week 7</b>	<b>March 3</b> Planets around other stars. [7.1]	<b>March 5</b> Exoplanet pot-pourri. [7.2,15.2]	<b>March 7</b> Radiation and spectroscopy. [8.1,8.3]
<b>Week 8</b>	<b>March 10</b> The Sun. [8.1]	<b>March 12</b> Stars. The HR diagram. [8.2,8.3]	<b>March 14</b> Spring recess.
<b>Week 9</b>	<b>March 17</b> Stellar structure. [9.1]	<b>March 19</b> Variable and double stars. Novae. [8.2,10.1,12.1]	<b>March 21</b> White dwarfs and neutron stars. [10.1]
<b>Week 10</b>	<b>March 24</b> Spring Break.	<b>March 26</b> Spring Break.	<b>March 28</b> Spring Break.
<b>Week 11</b>	<b>March 31</b> Black holes. [10.2]	<b>April 2</b> Stellar explosions! Gamma-ray bursts and supernovae. [9.2,10.1-10.3]	<b>April 4</b> Gravitational waves. [10.3]
<b>Week 12</b>	<b>April 7</b> The life cycle of the stars. [9.2,9.3]	<b>April 9</b> The milky way. Star clusters. Interstellar gas. [11.1]	<b>April 11</b> The galaxy zoo. [11.2]
<b>Week 13</b>	<b>April 14</b> Galaxy evolution, clusters, and supermassive black holes. [11.3]	<b>April 16</b> Second midterm review.	<b>April 18</b> Second midterm exam.

**Part III: The universe** (Roughly chapters 12-14, April 21 through May 9. Section numbers are approximate.)

	<b>Monday</b>	<b>Wednesday</b>	<b>Friday</b>
<b>Week 14</b>	<b>April 21</b> Guest lecture: cosmology in the making.	<b>April 23</b> The cosmic distance ladder. [12.1]	<b>April 25</b> The expansion of the universe. [12.2]
<b>Week 15</b>	<b>April 28</b> The big bang theory. [13.1]	<b>April 30</b> Evidence for the big bang. [13.2]	<b>May 1</b> Inflation. [13.2]
<b>Week 16</b>	<b>May 5</b> Dark matter. [14.1]	<b>May 7</b> Dark energy and the fate of the universe. [14.2,14.3]	<b>May 9</b> Final review.