Astronomy 1115 Syllabus

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Welcome to Astronomy 1115! This online Astronomy course covers the study of objects in space, but it can give us a lot of information about Earth as well, including new Physics, information about how the Earth was formed, and even help us locate ourselves in time and space! Astronomy 1115 is the introductory Astronomy course, complemented by its lab section Astronomy 1115L. Please note I reserve the right to change this syllabus if I see it fit to do so throughout the semester. **(pre- or co-requisite: None)**

Textbook and tools

The textbook for the course, *Astronomy* from OpenStax, is free! However, it's also crucial to the course, so be sure to download it from https://openstax.org/details/books/astronomy with time to spare. Regular weekly readings and homework will be assigned from the textbook, and homework, quizzes, and tests will derive from text and lecture material.

Since this is an online course, homework will be completed on Word and submitted through UNM Learn. A free alternative to Word that you can download is Libreoffice, available at https://www.libreoffice.org/download/download/. You are also expected to have access to high-speed internet and a computer. You can do this at the computer labs on campus or a public library if you prefer. Finally, be sure you can open pdf files; if you can't open the homework files on http://helasraizam.github.io, you can download Adobe Reader for free at https://get.adobe.com/reader/.

Objectives

Topics to look forward to include a brief history of Astronomy, an analysis of the behavior of stars and planets as seen from Earth, applying the scientific method, understanding the scales of the universe, how to use tools like telescopes and spectroscopes to observe and quantify the stars, a study of the formation and properties of objects in our solar system, na overview of gravity and electromagnetism, methods of discovery of planets around stars, the structure and activity of the Sun and its contextualization with other stars, the life cycle of a star, the structure of the Milky way and its comparison to other galaxies, the Big Bang theory in the context of recent observations, and the possibility of extraterrestrial life in the universe. See Appendix B for the full list of objectives, and Appendix A for the tentative schedule.

Grading

The grading is outlined below, with grade percentages on the border resulting in the higher grade:

Homework	40%	99-100	A+	87-90	B+	70-80	C
Projects	40%	94-99	A	84-87	B	60-70	D
Quizzes	20%	90-94	A-	80-84	B-	0-60	F

Please see UNM Learn or http://helasraizam.github.io for a table of due dates. Due dates are subject to change without notice, so please check the course schedule often. Every week, you're expected to keep up with the recorded lecture(s), review the course notes, and complete the weekly homework and quiz on UNM Learn. If you feel you are falling behind, contact me as soon as possible. **All work is due at 11:59 pm at the date posted on UNM Learn**, and you should expect your work to be graded within two weeks of its deadline. Feedback will be on the UNM Learn submission, in comment boxes. You must submit a word (.doc) or pdf (.pdf) file.

You must show your work to get full credit and good feedback (I can't give you partial credit if I don't know why your answer is wrong!); you can take pictures of your work and copy/paste it into the word document. All assigned work will include a point layout describing how many points each problem and sub-problem is worth—if parts of a problem don't have points assigned, you should assume the points for that problem are evenly distributed. On rare occasions I will reassign the points based on student performance (e.g., if a question has a typo)—these reassignments will be to your benefit.

Quizzes (20%)

The quizzes are basic questions to assess your understanding of that lecture. You can find the quizzes on UNM Learn.

Homework (40%)

The homework is designed to extend your understanding. Homework will be typed on your computer and submitted on UNM Learn. You can use Word, or you can download Libreoffice, a free alternative, at https://www.libreoffice.org/download/download/. You are encouraged to attend office hours and discuss the topics of the homework on the UNM Learn forums (without posting the answers).

Projects (40%)

The course is divided into four modules. Three projects will test your understanding of each module, with the third project covering topics in Modules 3 and 4. You should plan to type up the projects. You should leave plenty of time for the projects. The projects extend the homework questions and require your own critical thinking to ensure that you've understood the material.

Tutoring and Support

You are encouraged to send me and your classmates your questions on the topics covered in the course on the UNM Learn discussion page for the appropriate chapter(s); this helps your other classmates who may have the same questions. You should expect a response within 24 hours of a post. Please don't make the mistake of thinking you're the only one not to understand a topic—if you don't understand a topic, chances are your peers don't either, and bringing it up will remind me to cover it during office hours or the next lecture.

In-person tutoring is also available at the Learning Center, see http://valencia.unm.edu/campus-resources/the-learning-center/index.html. If you're spending more than four hours on the homeworks, please let me know.

Online Course

This is an online course, meaning you'll have to schedule the time during the week to watch the lectures, complete the quizzes, assignments, and projects on your own. You should do your best not to fall behind as it will be detrimental to your grade. You should plan to spend 6-9 hours a week for this class, which includes new topics introduced in lectures.

Students with Disabilities

Qualified students with disabilities needing appropriate academic adjustments should contact me as soon as possible to ensure your needs are met.

Title IX

UNM faculty are considered "reponsible employees" by the Department of Education.[1] This designation requires that any report of gender discrimination which includes sexual harassment, sexual misconduct, and sexual violence made to a faculty member, TA, or GA must be reported to the Title IX Coordinator at the Office of Equal Opportunity (oeo.unm.edu). For more information on the campus policy regarding sexual misconduct, see: https://policy.unm.edu/university-policies/2000/2740.html.

[1] See p. 15 - http://www2.ed.gov/about/offices/list/ocr/docs/qa-201404-title-ix.pdf

A Tentative Course Schedule

This is a tentative course schedule, it is subject to change. Do not use the table below for reference, instead examine the course schedule on UNM Learn or https://helasraizam.github.io.

Due date	Chapter(s)	Assignments
Module 1	Introduction	Homework 0
08/25	0: Mathematical Background	Quiz 0
	1: Science and the Universe	Entry Survey
09/01	0.5 - Numbers in Science	Homework 1
	2: Observing the Sky	Quiz 1
	3: Orbits and Gravity	
09/08	3.5: Orbits and Gravity	Homework 2
	5: Radiation and Spectra	Quiz 2
09/15	6: Astronomical Instruments	Homework 3
	4: Earth, Moon, and Sky	Quiz 3
Module 2	7: Other Worlds	Homework 4
09/22	8: Earth as a Planet	Quiz 4
09/29	9: Cratered Worlds	Homework 5
	10: Venus and Mars	Quiz 5
		Project 1
10/06	11: The Giant Planets	Homework 6
		Quiz 6
10/13	13: Comets and Asteroids	Homework 7
	14: Cosmic Samples and the Origin of the Solar System	Quiz 7
Module 3	15: The Sun: A Star	Homework 8
10/20	16: The Sun: A Nuclear Powerhouse	Quiz 8
10/27	19: Celestial Distances	Homework 9
		Quiz 9
		Project 2
11/03	17: Analyzing Starlight	Homework 10
	18: The Stars	Quiz 10
11/10	21: The Birth of Stars, Exoplanets	Homework 11
	22: Stars from Adolescence to Old Age	Quiz 11
	23: The Death of Stars	
Module 4	24: Black Holes and Curved Spacetime	Homework 12
11/17	25: The Milky Way Galaxy	Quiz 12
11/24	26: Galaxies	Homework 13
	27: Active Galaxies, Quasars, and Supermassive Black Holes	Quiz 13 **Project 3**
12/01	29: The Big Bang	Homework 14
	30: Life in the Universe	Quiz 14
12/08		

B Course objectives

By the end of the course, the student should be able to:

1. Discuss the night sky as seen from Earth, including coordinate systems, the apparent daily and yearly motions of the sun, Moon, and stars, and their resulting astronomical phenomena.
   (a) Describe the phases of the Moon based on the position of the Earth, Sun, and Moon.
   (b) Describe the use of various celestial objects in ancient calendars and astrology.
   (c) Desribe and employ celestial and geographic coordinate system and how they relate.
   (d) Describe the cyclical motions of stars and celestial objects and how they can be used to find one's earthly coordinates.
   (e) Explain and employ the motion of the celestial sphere in locating celestial phenomena.
   (f) Explain counterintuitive celestial phenomena such as retrograde motion.
2. List and apply the steps of the scientific method.
   (a) List and explain the steps of the scientific method.
   (b) Explain the importance of the scientific method.
3. Describe the scale of the Solar System, Galaxy, and the Universe.
   (a) Describe different units of measurement such as kilometers, astronomical units, lightyears, and parsecs.
   (b) Ascribe these units appropriately to different celestial scales.
   (c) Compare the scales and distances between comets, asteroids, meteors, dwarf planets, planets, different types of stars, quasars, galaxies, and the universe.

4. Explain telescope design and how telescopes and spectra are used to extract information about Astronomical objects.
   (a) Explain the atomic origin and effects of light and the basics of underlying atomic structure.
   (b) Describe the attributes that characterize different types of electromagnetic radiation.
   (c) Perform basic calculations to determine properties of electromagnetic radiation.
   (d) Employ quantum principles to describe the origin and unique elemental fingerprint absorption and emissions spectra.
   (e) Explain how light from an object can divulge its composition, distance, temperature, and radial velocity.
   (f) Explain how telescopes work in basic terms.
   (g) Explain the criteria for excellence for telescopes measuring varying parameters (e.g., different wavelengths of light).
5. Describe the formation scenarios and properties of solar system objects.
   (a) Describe in detail the models of formation for the solar system and the objects that make it up.
   (b) Explain the connection between solar system formation events and the unique development of planets within it.
   (c) Describe models for the formation and present state of the terrestrial planets.
   (d) Describe how the formation and development of planets relate to Earth's present and future state.
6. Describe gravity, electromagnetism, and other physical processes that determine the appearance of the universe and its constituents.
   (a) List, compare, and briefly explain the four fundamental forces.
   (b) List, explain, and employ Newton's and Kepler's laws in basic problems.
7. Describe methods by which planets are discovered around other stars and current results.
   (a) List methods by which planets are discovered around stars, both in our solar system and in stellar systems so far away they look like just a single dot!
   (b) Describe and employ various methods to detect planets outside of the solar system.

8. Describe the structure, energy generation, and activity of the sun.
   (a) Describe the nuclear fusion processes that provide the Sun with its energy and perform basic calculations.
   (b) Describe the structure of the Sun, its activities, and their effects on our solar system.
9. Compare our sun to other stars and outline the evolution of stars of different masses and its end products, including black holes.
   (a) Explain the difference between meteorites, meteors, comets, asteroids, dwarf planets, planets, stars, and quasars.
   (b) Explain how different starting conditions or phenomena in a celestial object's life cycle leads to its categorization as one of the above.
10. Describe the structure of the Milky Way and other galaxies and galaxy clusters.
    (a) Describe the formation of galaxies and galaxy clusters.
    (b) Compare the structure and formation of our galaxy in the context of other galaxies.
    (c) Describe the compositions, ages, and locations of varying types of celestial objects in our galaxy.
11. Students will describe the origin, evolution, and expansion of the universe based on the Big Bang Theory and recent Astronomical observations.
    (a) Describe the Big Bang model as a model for the origin of the universe.
    (b) Describe the accelerating expansion of the universe.
    (c) Employ the expansion of the universe in basic Hubble's Law calculations.
12. Students will describe conditions for life, its origins, and possible locations in the universe.
    (a) Explain the conditions for life outside of Earth.
    (b) Discuss specific examples of habitable zones outside of the solar system.
    (c) Calculate a rough estimate for the probability of intelligent life in the Milky Way.