INQ 250: Astronomy Controversies of the Modern Era SP 2024

Instructor: Dr. Truong Le (he,him,his)
Office: Trexler 266B
Email: tle@roanoke.edu

Credits for the course: 1
Lectures Time: TTH 10:10-11:40 am
Lectures Room: Miller Hall, 012

Class Environment: I consider this classroom to be a place where we will treat one another with respect, creating an environment that welcomes individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, ability and other visible and nonvisible differences. All members of this class are expected to contribute to a respectful, welcoming and inclusive environment for every other member of the class. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the course so that I may make appropriate changes to my records. **This syllabus will continue to change with students' notice.**

Office Hours: MWF (11-12 pm), and by appointment.

Course Description: Introduces the methodologies of the natural sciences through an inquiry-focused approach to a topic. Students will explore the types of questions that science asks and how it attempts to answer them by defining and classifying information, developing models, identifying patterns, and drawing conclusions based upon data (Credit cannot be received for both HNRS-250 and INQ-250 from the same discipline).

Aspiration: How do the scientific processes of observation, measurement, and theorizing help to create and resolve controversy within the sciences? Is it healthy to maintain controversy regarding theories and models in the sciences; i.e., do the sciences thrive on controversy? How is controversy received and interpreted by the larger society and culture? By examining some well-known controversies within the astronomical sciences, we will explore both the quantitative arguments and the historical contexts in answering the above questions. Since physics is the proper background for astronomical studies, the course will also focus on the physical concepts and processes associated with astronomical objects. You will also take measurements, observe astronomical objects with telescopes, and interpret graphicallypresented data through a required lab.

Course Material: Required and recommended

- **Calculator (required):** A scientific calculator.
- **Text (required):** Astronomy (OpenStax: https://openstax.org/details/books/astronomy) by Andrew Fraknoi, David Morrison, and Sidney Wolff.
- **Text (required):** College Physics (OpenStax:https://openstax.org/details/books/college- physics) by Paul Urone and Roger Hinrichs.

Laboratory: You must be enrolled in the laboratory portion INQ 250L of this course. Although INQ 250L operates as a separate course, it counts as 20% of the course grade for INQ 250. Please refer to the lab course syllabus for important information about the lab specifics and final grade.

Goals & Objectives: All sections of INQ 250 share a common set of learning outcomes related to the skills students will develop in this course. These outcomes are:

- Students will be able to describe and apply scientific methodologies appropriate for the course?s discipline and topic, including the ability to design and conduct simple experiments and to draw conclusions based upon data.

- Students will be able to write about course topics clearly and effectively.
- Students will be able to interpret quantitative information related to the course topic.

Our task is large, as we go through the course, however, the emphasis will be on topics from physics and astronomy, but I will try to balance our discussion to include history, philosophy, and mathematics, as well as working on some of the fundamental physics and astronomy problems that will allow us to understand those topics more deeply. A set of course-specific secondary learning outcomes which enhance and support those outlined above, have also been developed and are presented below. The goals and objectives specific to each learning outcome are presented as sub-items below each learning outcome. By the end of this course, students will also be able to:

- Understand fundamental historical, philosophical, and physical concepts, principles, and ideas.
- Understand major ideas and concepts that have shaped and are shaping 21st century scientific thought and discoveries.
- Understand connections between past, present, and future scientific developments and discoveries that have come to shape our conceptions of the universe.
- Understand and identify the major contributions of individual philosophers, scientists, astronomers, mathematicians, who have played a role in helping to develop our understanding of the universe. • Appreciate science and the fundamental ideas and laws that govern the Universe.

Expectation: This course expects you to spend at least 12 hours of work each week inside and outside of class during the regular semester. During the summer the expectation is about 40 hours per week.

Participation/miniProject/tutorial: Tutorial or mini projects will occur almost in every lectures. Students need to submit these material on Inquire for credit.

Homework: Homework will be assigned on **Tuesday at 10 pm and they are due the next Tuesday at midnight**. There will be 20-30 multiple choice problems per homework. Be prepared to spend about 2 hours on each homework. If you are spending more time than this, then please meet with me immediately. The homework will be on Inquire. You are allowed to work on your HW together, which means discuss the ideas and things you don't understand until you do. Many of the problem-solving types will be in the midterm and final. So you will be happiest if you understand what you are doing. The point of homework is to practice thinking, not copying a solution algorithm from another source. **You need to submit all assigned problems on-time before the due date to receive full credit.**

Exams: There will be two exams in this course. The exams will be open notes and homework. **Any missed exam will count as zero points unless it is an excused absence (illness, participation in a scheduled College event, etc.), which should be cleared with me before or immediately following the missed class. The missed exam may be made up in a way decided by the instructor.**

Project: This assignment is intended to be significantly different from the homework or exams. This is a group project. What I am providing is an opportunity for you to use your creativity to express your understanding of a topic related to either of our course themes. You may select a topic based on your readings, class lectures and discussions, or any of the video segments. All projects will require a written commentary. In your commentary you will be asked to clearly explain your project and its significance. You should also address how your topic in some way can be connected to one or more historical cosmological models. Possible topics for your creative projects include (but are not limited to):

- The creation of a piece of artwork (e.g. a collage, drawing, painting, sculpture, a particular model of the universe, etc.).

- A musical expression of some type (e.g. writing a song, creating an interpretive dance). • A creative literary piece (e.g. a piece of poetry, a short story, creation of a website, a blog, a piece of science journalism such as an interview with a scientist, cosmologist, astronomer, etc.). • The construction of a scientific model, machine, instrument, or piece of equipment that illustrates a specific concept or idea.
- The creation and performance of a short skit or play.
- You might also create a video that might serve as a stand-alone piece or that might accompany your project.
- The creation of something edible. This might be a stretch, but I would be willing to entertain this idea.

You will need to submit a short proposal outlining your proposed creative project in order to have your topic approved. In order to get your project approved, you will need to demonstrate in your proposal how you plan to tie your project in to one or more historical cosmologies and their original source materials. In addition, your proposal must include at least one properly documented citation of the original source material(s) you will be utilizing in your project. Additional details about the creative project assignment will be provided in class. Students will present a 10-minute presentation of their project at the end of the semester.

Grading: Your grade in this class will be determined by a combination of project, exams, homework, laboratory, and class participation. The separate weightings will be:

Class Participation (Mini Project/tutorial): 10%

Homework: 20%

Laboratory: 20%

Project: 10%

Midterm: 20% **Final:**

20%

Final Grade: Final course grades will be assigned using the following scale:

A	93% or more	C+	77-79.9%
A-	90-92.9%	C	73-76.9%
B+	87-89.9%	C-	70-72.9%
B	83-86.9%	D	60-69.9%
B-	80-82.9%	F	below 60%

Accessible Education Services (AES): located in the Goode-Pasfield Center for Learning and Teaching in Fintel Library. AES provides reasonable accommodations to students with documented disabilities. To register for services, students must self-identify to AES, complete the registration process, and provide current documentation of a disability along with recommendations from the qualified specialist. Please contact Becky Harman, Assistant Director of Academic Services for Accessible Education, at 540-375-2247 or by e-mail at aes@roanoke.edu to schedule an appointment. If you have registered with AES in the past and would like to receive academic accommodations for this semester, please contact Becky Harman at your earliest convenience to schedule an appointment and/or obtain your accommodation letter for the current semester.

Academic Integrity: Your learning and integrity are at the core of your RC education. For this reason, you must follow the rules outline in the College AI policies. See https://www.roanoke.edu/inside/az index/academic_affairs/academic integrity. **If I become aware of a possible violation of these guidelines, I am contractually obligated to report it to the Academic Integrity committee.**

Preliminary Schedule: Topics of discussion from my lectures and videos. I will inform you the reading material at the beginning of every class:

Dates	**Topic**	**Lab**
	Is the Earth at the center of the universe?	
W1: Jan 16	Welcome and Course Introduction	**No lab first week**
Jan 18	Tour of the universe: Estimating,	**of class**
	orders of magnitude, factors of 1000	
	Angular Size & Field of Views	
W2: Jan 23	Early civilization, Greek civilization	1. Scale the solar system
Jan 25	Retrograde motions & Motion of the Sun	
W3: Jan 30, Feb 1	Scientific Rev. I: Copernicus, Kepler, Galileo	2. AngularSize-FieldofView
W4: Feb 6, 8	Scientific Rev. II: Newton, velocity,	
	acceleration, force, circular motion	3. Outdoor/Telescope
	gravity, and Universal gravity	
	Are there planets beyond our solar system?	
W5: Feb 13	Properties of the solar system	4. Night Observation
Feb 15	Early hypotheses of the solar system	
W6: Feb 20	Exoplanets	5. Kepler Laws
Feb 22	Escape Velocity and the Earth's Atmosphere	
W7: Feb 27	Light and Stars Project Distributed (4/group) Review for Midterm	6. Extrasolar Planets
Feb 29	**Midterm**	
W8: Mar 4-8	**Spring Break**	
	Are there black holes?	
W9: Mar 12	light, stars, and white dwarfs	7. Planck Radiation
Mar 14	neutron stars, black holes	
W10: Mar 19, 21	Einstein's Special Relativity	8. Black Hole
Mar 22	**Project Proposal Due**	
	Is there one galaxy or many?	

W11: Mar 26,28	Einstein's General Relativity & Cepheids Variable and Galaxies	9. Hubble Deep Field
	Did the universe have a beginning?	
W12: Apr 2, 4	Galaxies and Dark Matter	10. Dark Matter
W13: Apr 9, 11	An Expanding Universe	11. Solar Eclipse Obs.
W14: Apr 16, 18	The Fate of the Universe	12. Hubble's Law
W15: Apr 23	Review for Final (Last day of class)	13. Project Presentation
Apr 29	**Final Exam (time - 8:30-11:30 am)**	

I have read and understood this syllabus. Sign, date, and submit this page for 10 points toward your participation grade on your first day of class.

Student's Name: **Date:**