Astronomy/Physics 410: Astrophysics
Fall Semester 2009 (3 Credits)

Description: This course focuses on the application of introductory physics to astrophysical situations. We begin with a review basic orbital mechanics and the interaction of matter and light. Following this review of basic classical physics, we will introduce advanced interactions between light and matter, basic stellar structure, stellar evolution, and the Galaxy. **Prerequisite:** PHYS 322

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Class Homepage: *http://iparrizar.mnstate.edu/~juan/classes/astrophys410/*
or
http://astrophys410.cabanela.com/

Required Textbook: Ryden and Peterson, *Foundations of Astrophysics*

This title is available at the MSUM Bookstore for $137.35 New ($103.05 Used, if available). The ISBN is 0-321-59558-4 and I have seen it for sale online for considerably less. If you order a copy online, be aware I expect you to have the textbook in hand by the end of the second week of classes.

Lecture Times: Tuesdays and Thursdays, 9:00 am – 10:15 am

Astrophysics is the science of physics applied to astronomical situations. Since the time of Galileo, our physics has informed understanding of astronomical situations, but in the last century, astronomy has also informed our understanding of fundamental physics. This course will cover: introductory celestial mechanics (Newton's Gravity), the interaction of light and matter, telescopes and detectors, stellar properties and models for stellar interiors, stellar evolution, and possibly the Milky Way galaxy.

Course Objectives:

By the end of this course you should be able to:

- Understand some of the terminology unique to astronomy.
- Apply Newton's Theory of Gravity and Kepler's Laws to interactions between astronomical objects.
- Use an understanding of light and its interactions with matter in order to analyze astronomical data including optical and non-optical imaging and basic spectroscopy.
- Explain the basic physical properties of stars and how we have determined them.
- Explain our theoretical understanding of stellar interiors, specifically the conditions necessary for hydrostatic equilibrium, as well as applying that understanding to other astronomical situations, such as planetary atmospheres.
- Be comfortable reading journal articles and trying to extract information from them.

Grade Assessment:

Grading in this course will be based on the following criteria:

- **Homework assignments: (35%)** Roughly each week you will be responsible for turning homework based on your individual work. It is OK to check with the instructor or each other to see if there is agreement, but it is not OK to expect someone else to solve the assignment for you. Furthermore, if you work with someone, you must state clearly on your homework who you worked with. **You are expected to turn in your homework (into Prof. Cabanela's hands) on time. Unexcused late homework will not be considered for grading. Prof. Cabanela is the sole arbiter of what makes homework excusably late.**
- **Journal Articles: (20%)** Roughly every month there will be a journal article listed on the homework. You will have to read that journal article and write up 2 questions that you answered either within the journal article or by some external research. The questions should be harder than "how do you spell galactic", but easier than a full research project. I expect about a 1-2 page write up for each of these.
- **In Class Activities: (5%)** I will try to provide some in class activities during some of the lectures in order to provide something more entertaining than my voice. Participation in these activities will be rewarded.
- **Exams: (40%)** There will be two mid-term exams during the semester in addition to the final exam. Study Guides showing the list of topics covered or each exam will be provided.

Final grades will be assigned on the scale below; **plusses and minuses will be used**. I reserve the right to adjust the grade curve if necessary.

A	B	C	D	F
≥90%	80%-90%	65%-80%	50%-65%	<50%

Academic Honesty

From the Student handbook (*http://www.mnstate.edu/sthandbook/academic_info/academicpolicies.htm#academichonesty***):**

The University expects all students to represent themselves in an honest fashion. In academic work, students are expected to present original ideas and give credit for the ideas of others. The value of a college degree depends on the integrity of the work completed by the student. When an instructor has convincing evidence of cheating or plagiarism, the following actions may be taken: assign a failing grade for the course in which the student cheated or instructors may choose to report the offense, the evidence, and their action to the Dean of their college or the Vice President for Academic Affairs. If the instructor (or any other person) feels the seriousness of the offense warrants additional action, the incident may be reported to the Student Conduct Committee through the Student Support Services Office. The Student Conduct Committee will follow procedures set out in the Student Conduct Code. After its review of the case and a fair, unbiased hearing, the Student Conduct Committee may take disciplinary action if the student is found responsible (see Student Conduct Code for details).

A student who has a course grade reduced by an instructor because of cheating or plagiarism, and who disputes the instructor's finding, may appeal the grade, but only by using the Grade Appeal Policy, which states that the student must prove the grade was arbitrary, prejudicial, or in error.

In this course, all instances of academic dishonesty will be reported to the Dean of the College of Social and Natural Sciences for informational purposes. I take academic dishonesty as a violation of the implied agreement between I, as an instructor, and you, as a student, to provide you with the best opportunity to learn about astrophysics. Any academic dishonesty believed to be intentional will result in a failing grade for the entire course.

Special Accommodations

Students with disabilities who believe they may need an accommodation in this class are encouraged to contact Greg Toutges, Coordinator of Disability Services at 477-5859 (Voice) or 1-800-627-3529 (MRS/TTY), CMU 114 as soon as possible to ensure that accommodations are implemented in a timely fashion.

Tentative Lecture Topic Schedule

This schedule is tentative and possibly too optimistic, so I reserve the right to adjust as necessary.

The Week following Monday...	Tuesday Lecture	Thursday Lecture	Homework
Aug 24	Intro. To Class/ Timekeeping [Solar vs. Sidereal] [R&P 1.5]	Astronomical Geometry and Determining the Size of the Solar System [R&P 2.3, 2.5]	
Aug. 31	Celestial Mechanics (Deriving Kepler's Three Laws) [R&P 3.1]	Orbits and the Virial Theorem [R&P 3.2 - 3.4]	PS01 Due Friday, Sept. 4, 4pm
	Dr. Cabanela in Germany, Dr. Craig guest lecturing		
Sept. 7	Differential Gravitational Forces [R&P 4.2 and 4.3]	Atomic Structure [R&P 5.1]	PS02 and 1st Journal Article Due Friday, Sept. 11, 4pm
Sept. 14	Spectra [R&P 5.2 to 5.3]	Equation of Radiative Transfer and LTE [R&P 5.4 to 5.6]	PS03 Due Friday, Sept. 18, 4pm
Sept. 21	Blackbody Radiation [R&P 5.7]	Telescopes and Detectors [R&P 6]	PS04 Due Friday, Sept. 25, 4pm
Sept. 28	Detecting Exoplanets [R&P 12.3]	Stars: Distances and Magnitudes [R&P 13.1 to 13.2]	PS05 Due Friday, Oct. 2, 4pm
Oct. 5	**Mid-Term Exam #1**	Stars: Temperatures, Sizes, and Masses [R&P 13.3 to 13.5]	2nd Journal Article due Friday, Oct. 9 4pm
Oct. 12	**NO CLASS**	Stars: Relationships between Physical Properties [R&P 13.6]	PS06 Due Friday, Oct. 16, 4pm
Oct. 19	Hydrostatic Equilibrium [R&P 9.2, 14.1]	Spectral Classification [R&P 14.2 to 14.3]	PS07 Due Friday, Oct. 23, 4pm
Oct. 26	Equations of Stellar Structure [R&P 15.1, 15.4]	Energy Generation in Stars [R&P 15.2 to 15.3]	PS08 Due Friday, Oct. 30, 4pm
Nov. 2	The ISM and Stellar Formation [R&P 16 (brief), 17.1]	Stellar Evolution [R&P 17.2 for Low-Mass]	PS09 Due Friday, Nov. 6, 4pm
Nov. 9	Stellar Corpses: White Dwarfs and Neutron Stars [R&P 18.1 and 18.2]	Stellar Corpses: Black Holes and Supernovae [R&P 18.3 and 18.4]	PS10 Due Friday, Nov. 13, 4pm
Nov. 16	**Mid-Term Exam #2**	Our Galaxy: Structure and Dynamics [R&P 19.1 to 19.4]	
Nov. 23	Our Galaxy: Oort's equations [R&P 19.5 to 19.6]	**NO CLASS**	Third Journal Article Due **Tuesday, Nov. 24, 4pm**
Nov. 30	Our Galaxy: The Nucleus [R&P 19.7]	Other Galaxies [R&P 20.1 to 20.3]	
Dec. 7	Measuring Distances to Galaxies [R&P 20.4 to 20.5]	**NO CLASS**	PS11 Due **Tuesday, Dec. 8**, 4pm

Our Final Examination is scheduled for Monday, December 14 at 9 am.