ASTR 316: Stars & Galaxies — Winter 2016

Course Information

Instructor: Dr. Kevin R. Covey (kevin.covey@wwu.edu; 360-650-3837)
Class Location/Times: CF 316; TR, 10:00-11:15am
Office Hours: M 2-3, T 2:30-3:30, F 10-11 in CF 365, or by appt.
Prerequisites: Completion of the first year physics sequence (114/115/116 or 161/162/163).

Course Content

Physical processes in stellar and Galactic astrophysics, including: the nature of light and its interaction with matter; observable properties of the Sun and stars; stellar interiors and evolution; kinematics, spatial structure, and stellar populations of the Milky Way.

Learning Outcomes

After this course, students will be able to:

- use figures and graphs and natural language to *qualitatively* describe the physical processes that govern the properties and evolution of stars and our Galaxy.
- make computations, using paper+pencil and computational tools, to *quantitatively* describe the physical processes that govern the properties and evolution of stars and our Galaxy.
- create written documents that communicate scientific and technical concepts *effectively* (ie, in a *clear, concise,* and *well-organized* manner).
- demonstrate the ability to work individually and in groups.

Required Materials

Text: Foundations of Astrophysics, by Ryden & Peterson.

Access to iPython installation with basic python packages: Students will use iPython Notebooks to complete computational problems based on real astrophysical data. Students have access to an iPython installation in the computer lab in CF312; students may also complete these problems on their personal computers by installing iPython and associated packages (numpy, scipy, matplotlib, etc.).

Canvas: Announcements, assignments, etc. will be posted via Canvas. Updates will be announced during class time, but students should check the site regularly.

ABCD card + Pencil/Pen + Paper: Class sessions will often include 'Think-Pair-Share' questions to be answered with the ABCD response cards distributed in class, as well as short writing assignments and problem solving sessions. Come ready to participate, think & learn.

Final Course Letter Grade

Students earn their letter grade in the course by achieving overall course scores of:

A ≥ 93%	A- ≥ 90%	B+ ≥ 87%	B ≥ 83%	B- ≥ 80%	C+ ≥ 77%
	C ≥ 73%	C- ≥ 70%	D+ ≥ 67%	D ≥ 63%	D– ≥ 60%

Limits for letter grades may be lowered, but not raised, at the instructor's discretion. (ie, a curve will only help your grade, not harm it).

Graded Course Activities

Weekly Problem Sets (**30%** of course grade; lowest score dropped): Students will demonstrate their mastery of the course material by writing up solutions to weekly problem sets. Problem sets will be good practice for course exams, and will be **due at the beginning of each Tuesday's class. Late work will be accepted, but will be penalized 15% per weekday up to a maximum penalty of 50%.** Students must show all work and demonstrate an understanding of the material to receive full credit; see the problem grading rubric on Canvas for more details on how problems are graded.

Computational Problems (**15%** of course grade; lowest score dropped): Computational problems will enable students to work directly with modern astrophysical data, developing technical skills that are critical for a wide range of scientific and technical careers. Each student must complete the first computational problem individually; subsequent problems may be completed with a classmate, with pairs of classmates assigned by the instructor. **Due dates for computational problems will be announced when they are assigned; at least a week will be given to complete each problem. Late work will be accepted, but will be penalized 15% per weekday up to a maximum penalty of 50%.** Students must show all work and demonstrate an understanding of the material to receive full credit; see the problem grading rubric on Canvas for more details on how problems are graded.

Oral Presentations (**10%** of course grade): During the last two weeks of the course, students will work in small groups to develop handouts and give short (<15 minute) oral presentations on the structure, dynamics, and history of our Milky Way. The instructor will assign grades after evaluating the oral presentation & handouts, along with input from self, team, and peer evaluations. A full description of the assignment and grading procedure will be posted to Canvas on Feb. 2nd, along with a list of possible presentation topics. Students will indicate their preferred topics by returning a ranked list on Feb. 9th; based on these preferences, the instructor will assign groups and presentation slots on February 11th.

Midterms + Final Exam (**15%** of course grade each): Midterms will take place during our regular class time on **Tuesday, January 26th** and **Tuesday, February 23rd;** the final exam is scheduled for **8-10am Monday, March 14th.** Exams are closed book, but students may use calculators and a single 3x5″ card/sheet of notes. To ensure fairness for everyone, opportunities to make up exams will be offered only if circumstances preventing attendance constitute extreme, verifiable emergencies and if the instructor is notified before the exam occurs when possible.

Academic Honesty

Unless a problem is explicitly identified as a group assignment, students may work together to solve a problem, but final answers must be written up individually and provide an accurate summary of each student's work and understanding of the material. Outside sources can be consulted Cases of suspected academic dishonesty will be addressed following the policies laid out in Appendix D of the WWU Academic Catalog, which proscribes penalties ranging from a failing grade to expulsion from WWU in the case of multiple violations.

Course Accommodations

Reasonable accommodations will be made for students with letters from the Office of Disability Resources for Students (**drs@wwu.edu**; 360-650-3083; Old Main 120) or the Office of Student Life (**student.life@wwu.edu**; 360-650-3706; VU 506). Please present letters during office hours, so that we can discuss any accommodations, address concerns and create solutions.

Approximate Course Schedule

Note: Supplemental readings will likely be assigned for the later sections of the course; all such assignments will be announced in class and by Canvas at least 5+ days in advance. All readings should be completed by the beginning of Tuesday's class; that is, the reading should be done in advance of that week's classes, which will build on the material covered in the reading. Timing of readings & course topics are subject to change; exam dates are **not.**

Week	Topics	Main Text Readings	Schedule Notes
1 - Jan. 5 & 7	Overview; Blackbody Radiation; Bohr Model of the Atom; Solar Photosphere & Spectrum	Chap. 5 & 7.1	
2 - Jan. 12 & 14	Stellar Photometry: parallaxes, luminosities & magnitudes; temperatures and radii	Chap. 13.1-13.4	
3 - Jan. 19 & 21	Stellar Spectroscopy: Binaries & masses; surface gravities	Chap. 13.5, 14	
4 - Jan. 26 & 28	Stellar Interiors: Structure & Energy Transport	Chap. 15.1	**Midterm 1: Tues., Jan. 26th**
5 - Feb. 2 & 4	Stellar Interiors: Nuclear Fusion; Interstellar Medium	Chap. 15.2-15.3, 16.1-2	**Possible topics for MW presentations released**
6 - Feb. 9 & 11	Stellar Evolution: Red Giants +White Dwarfs	Chap. 17 and Sec. 18.1	**Preferences for MW presentations submitted; topics, groups & talk slots assigned**
7 - Feb. 16 & 18	Stellar Evolution: Neutron Stars, Black Holes, and Supernovae	Sec. 18.2-18.4	
8 - Feb. 23 & 25	Milky Way: Basic Structure + Kinematics	Chap. 19	**Midterm 2: Tues., Feb. 23rd**
9 & 10 - Mar. 1, 3, 8 & 10	Milky Way: Structure, Kinematics, Stellar Populations & Star Formation History	Chapter 19 & Supplementary Readings	**MW Presentations**
11 (Mar. 14)	Finals Week	Sec, 13.1-13.6	**Final Exam, Mon., March 14, 8-10am**

Updates (AKA the Small Print)

This syllabus, and the course schedule, are subject to change. Necessary changes will be announced in class and posted on Canvas.

ASTR 316: Grading Rubric

Each homework problem will be graded out of a total of 10 points, following the formula and criteria listed below.

Physical Reasoning (4 points possible):

4 points: Concepts and principles (mechanisms, symmetries, conservation laws, etc.) are clearly stated and employed correctly.

3 points: Appropriate concepts are utilized, but with minor weaknesses in their application or explanation.

2 points: Appropriate concepts are identified, but with major weaknesses in their application or explanation.

1 point: At least one appropriate concept is identified, but its relevance to the problem is not demonstrated or explained.

0 points: No appropriate concepts are identified.

Mathematical Reasoning (3 points possible):

3 points: All necessary equations and variables are given; mathematical steps to derive a final answer are clearly shown; answer is given symbolically before computing a numerical solution.

2 points: All necessary equations and variables are given, but minor errors yield an incorrect answer OR mathematical steps used to derive the symbolic solution are omitted.

1 point: Major errors or omissions in the equations and variables used to solve the problem, or in the mathematical steps used to derive a final symbolic solution.

0 points: No appropriate equations or variable are given.

Answer (2 points possible):

2 points: Answer is symbolically (i.e., equation & units) and numerically correct.

1 point: Answer is symbolically correct, but numerically incorrect.

0 points: Answer is neither symbolically nor numerically correct.

Organization and Clarity (1 point possible):

1 point: The solution is well organized, enabling an accurate and efficient assessment of the elements listed above. (i.e., each problem is labelled; an inch of blank space is given at the top and bottom of <u>each</u> problem for recording scores; handwriting is easily legible; pages are stapled, etc.)