

Physics 384 – ASTROPHYSICS – Fall 2022

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PHYS 384. Astrophysics. 3 cr. Selected topics in areas of astrophysics including planetary physics, stellar physics, galactic and extragalactic astronomy, and cosmology. Prereq: 250 and 300, MATH 222 or cons instr.

Meeting rooms/times:

Lecture (A207 SCI): Monday, Wednesday, and Friday 10:00-10:50 am

Office Hours:

I have scheduled five office hours weekly:

Monday 12:00 – 1:00 pm
Tuesday 10:00 – 11:00 am
Wednesday 12:00 – 2:00 pm
Thursday 10:00 – 11:00 am
(or anytime my office door is open)

Textbook: Introductory Astronomy & Astrophysics (4th Ed.) – Zeilik & Gregory

Other helpful supplemental textbooks (not required):

Astronomy – A Physical Perspective by Marc L. Kutner

An Introduction to Modern Astrophysics – Bradley Carroll & Dale Ostlie

Course website: Canvas <https://www.uwsp.edu/canvas/Pages/default.aspx>
<https://uwsa.instructure.com/courses/523757>

Log on using your UWSP login and password. *This website will be used for posting:*

- *grades for homework assignments and exams;*
- *class announcements; for example, change of due date for an assignment, comments on a homework problem, exam dates, etc.*

Software used: *Mathematica* (for some homework assignments)

Mathematica 13.1 is available via the *Software Center* for all UWSP devices. If you are not logged in directly to a UWSP device, you can access software available normally on campus via the Remote Lab: <https://www.uwsp.edu/infotech/Pages/ComputerLabs/Remote-Lab.aspx> Keep in mind that not all software is pre-installed but are available for installation as needed from the [Software Center](#).

Major Goal: applying and understanding fundamental physics concepts to a series of astronomical phenomena

Attendance: Attending the lecture is **extremely important** given the nature of this course. All demonstrations and derivations will be written on the board. The material requires constant attention. Attending class will likely be the single most important factor in determining your performance and grade in the course, so plan to attend every class. The relationship between attendance and achievement in education has been extensively documented in peer-reviewed research. I am not able to re-teach the material to you in the event that you are absent, but you can ask a classmate to share notes.

I will submit an attendance report to the registrar at the end of the second week of classes and constantly update the “attending” status of each student as we advance through the semester.

In case of potential time conflict between a scheduled exam and religious observances, the student must bring this to the instructor's attention within the first three weeks of the semester, according to the policy of the University.

Grading Policies:

You will have the following contribution to your final grade:

Three (in-class) exams – each 16%

Homework assignments – 30%

Final exam (comprehensive; in-class) –22%

Your current grades will be posted periodically (updated typically every week) on the class website (Canvas). If you have any questions regarding the listed grades please contact me immediately, so that any errors can be corrected.

The final letter grade will be assigned according to the following scale:

A → 93-100%	A- → 90-92.99%	
B+ → 87-89.99%	B → 83-86.99%	B- → 80-82.99%
C+ → 77-79.99%	C → 73-76.99%	C- → 70-72.99%
D+ → 67-69.99%	D → 60-66.99%	
F → less than 60%		

Exams:

Tentative dates for the midterm exams: October 3, October 31, and November 30

The final exam is scheduled for *Friday, December 16th 8:00-10:00 pm (Room A207 SCI)*

All other in-class exams during the semester will be given during the regular lecture time (Room A207 SCI). The dates of the exams during the semester are subject to change and will be announced in-class at least one week in advance.

There are no make-up exams. In the case of an unfortunate event (illness, death in the family, accident, etc.) please contact me before the exam (if at all possible) so that we could make proper arrangements. It is your responsibility to provide me with a valid doctor excuse for any illness that prevents you from fulfilling the requirements of this class.

Homework Assignments:

I will assign homework approximately every week. The due date will be clearly stated for each assignment and strictly enforced. No assignment is accepted after the decided due date & time.

Absences due to Military Service

You will not be penalized for class absence due to unavoidable or legitimate required military obligations, or medical appointments at a VA facility, not to exceed two (2) weeks unless special permission is granted by the instructor. You are responsible for notifying faculty members of such circumstances as far in advance as possible and for providing documentation to the Office of the Dean of Students to verify the reason for the absence. The faculty member is responsible to provide reasonable accommodations or opportunities to make up exams or other course assignments that have an impact on the course grade. For absences due to being deployed for active duty, please refer to the <https://www3.uwsp.edu/finaid/veteran-services/Pages/Call-Up-Guidelines.aspx>.

Equal Access for Students with Disabilities:

Students with special needs should contact the Disability Resource Center (DRC) as soon as possible (<https://www.uwsp.edu/disability-resource-center/>) in order to request suitable accommodation.

UW-Stevens Point will modify academic program requirements as necessary to ensure that they do not discriminate against qualified applicants or students with disabilities. The modifications should not affect the substance of educational programs or compromise academic standards; nor should they intrude upon academic freedom. Examinations or other procedures used for evaluating students' academic

achievements may be adapted. The results of such evaluation must demonstrate the student's achievement in the academic activity, rather than describe their disability.

If modifications are required due to a disability, please inform the instructor, and contact the Disability Resource Center to complete an Accommodations Request form. Phone: 715-346-3365 or Room 108 Collins Classroom Center (CCC).

Religious Beliefs Accommodation

It is UW System policy to reasonably accommodate your sincerely held religious beliefs with respect to all examinations and other academic requirements.

You will be permitted to make up an exam or other academic requirement at another time or by an alternative method, without any prejudicial effect, if:

- There is a scheduling conflict between your sincerely held religious beliefs and taking the exam or meeting the academic requirements; and
- You have notified your instructor within the first three weeks of the beginning of classes (first week of summer or interim courses) of the specific days or dates that you will request relief from an examination or academic requirement.

Academic Honesty: Students are expected to maintain the highest standards of academic integrity. Common examples of misconduct include but are not limited to: copying the homework from others, looking at notes while taking an exam, talking to others while taking an exam. Just to avoid the embarrassment and severe consequences of misconduct I would strongly advice that if you need some clarification during an exam or while working on homework, you should ask the instructor/proctor for help. More information on your rights and responsibilities are available at:

http://docs.legis.wisconsin.gov/code/admin_code/uws/14.pdf

UWSP 14.01 Statement of principles

The board of regents, administrators, faculty, academic staff and students of the University of Wisconsin system believe that academic honesty and integrity are fundamental to the mission of higher education and of the University of Wisconsin system. The university has a responsibility to promote academic honesty and integrity and to develop procedures to deal effectively with instances of academic dishonesty. Students are responsible for the honest completion and representation of their work, for the appropriate citation of sources, and for respect of others' academic endeavors.

UWSP 14.03 Academic misconduct subject to disciplinary action.

Academic misconduct is an act in which a student:

- (a) Seeks to claim credit for the work or efforts of another without authorization or citation;
- (b) Uses unauthorized materials or fabricated data in any academic exercise;
- (c) Forges or falsifies academic documents or records;
- (d) Intentionally impedes or damages the academic work of others;
- (e) Engages in conduct aimed at making false representation of a student's academic performance; or
- (f) Assists other students in any of these acts.

In case of emergency:

In the event of a medical emergency call 9-1-1 or use Red Emergency Phone. Offer assistance if trained and willing to do so. Guide emergency responders to victim.

In the event of a tornado warning, proceed to the lowest level interior room without window exposure. See www3.uwsp.edu/rmgt/Pages/em/procedures/other/floor-plans.aspx for floor plans showing severe weather shelters on campus. Avoid wide-span structures (gyms, pools or large_classrooms).

In the event of a fire alarm, evacuate the building in a calm manner. Meet at DUC. Notify instructor or emergency command personnel of any missing individuals.

Active Shooter/Code React – Run/Escape, Hide, Fight. If trapped hide, lock doors, turn off lights, spread out and remain quiet. Call 9-1-1 when it is safe to do so. Follow instructions of emergency responders.

See UW-Stevens Point Emergency Procedures at <https://www3.uwsp.edu/emergency/Pages/emergency-procedures.aspx> for details on all emergency response at UW-Stevens Point.

Final note: Common courtesy dictates that students attending a class should remain seated for the duration of class. While in class students should refrain from using phones, music players, headphones, etc. and should also refrain from gossiping/chatting while the professor is lecturing, and other students are listening and taking notes.

I am listing below some of the major (tentative) topics that we will cover in this course. The order is not necessarily accurate, nor complete. This course is not a survey of Astronomy. We will not cover the entire book.

TENTATIVE TOPICS

- Planetary orbits: Kepler's Laws and their physical interpretation, Newton's generalization; the meaning of mass and weight, virial theorem

Applications: planetary systems, binary stars, objects around BH in galaxies, rings around giant planets etc.

- Escape speeds, circular speeds, closed and open orbits

Applications: Maxwell's distribution of particles in a gas; planetary atmosphere retention

- Temperature relation between a planet and its star
- Applications of Special and General Relativity
- Black Holes
- Tidal forces
- Methods of detecting exoplanets
- Properties of light: wavelength, energy, diffraction, interference, Doppler effect
- Telescopes: properties, ground and space-based observatories
- Celestial sphere: coordinates altitude-azimuth, RA-Dec, Galactic Coordinates
- Atomic structure: Bohr's model, ionization, Boltzmann and Saha equations
- Plank's radiation, Wien's and Stefan-Boltzmann's Laws, Stellar Spectra
- Properties of the Sun; the Sun as a prototypical star
- Stars: distances, magnitudes, luminosities, masses, sizes (radii)
- HR diagram, Mass-Luminosity relation, Binary Stars

- Star formation (virial theorem) and the physical laws of stellar structure and evolution
- Stellar remnants: white dwarfs, neutron stars (physics of degenerate matter), pulsars, black holes
- Variable stars – distance to MW's center using P-L relation for Cepheid variables
- Interstellar reddening and absorption
- Galactic Rotation: stellar motions
- Structure of Milky Way
- Photometry of galaxies; properties of bulges, disks, bars
- Classification of galaxies: Hubble and others (de Vaucouleur, Kormendy & Bender, etc.)
- Tully-Fisher Relation
- Active Galaxies: superluminal motion, quasars
- Methods of determining (supermassive) black hole masses in galaxies
- Dark Matter – evidence
- Hubble Law and the expanding Universe