

Physics 384 – ASTROPHYSICS – Fall 2020

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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.

Delivery format: ONLINE ASYNCHRONOUS

Online (Virtual) Office Hours (via Zoom): Monday 3:00-4:00 p.m.

Thursday 4:00-5:00 p.m.

or by appointment

You will receive an email invitation for the Zoom Virtual office hours. The purpose of the office hours is to allow students to ask any kind of questions related to Phys 384 (lectures, homework, exams, etc.) or Astrophysics in general.

You can also schedule an individual meeting by emailing me. If your schedule conflicts with the listed time intervals, I am also available by appointment; you would have to send us an email and we can decide accordingly.

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

Other required materials: a portable scientific calculator (graphing capabilities not needed)

Course website: Canvas <https://www.uwsp.edu/canvas/Pages/default.aspx>

Log on using your UWSP login and password. *This website will be used for posting grades, homework assignments, exams, lecture notes/videos, 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 9.01 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

Grading Policies:

You will have the following contribution to your final grade:

Three midterm exams – each 16%

Homework assignments – 30%

Final exam (comprehensive) –22%

Your current grades will be available on the Canvas class website. 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%

Lectures: All lectures will be pre-recorded and posted in Canvas under Home→Lecture Notes/Videos. Watching the lecture videos is strongly recommended. It is **extremely important** for an effective learning process given the nature of this course. All demonstrations and derivations will be available in the videos. The material requires constant attention.

Homework Assignments:

I will assign homework approximately every week. The homework assignments will be posted on Canvas. They will be submitted online by the due date/time. The due date will be clearly stated for each assignment and strictly enforced. No assignment is accepted after the decided due date & time (usually by Friday at 11 am). Each homework will be available for a week with no time limit. Homework solutions will be available in Canvas after the due time/time and after the homework is graded.

Midterm Exams:

There will be **three** midterm exams during the semester. **Tentative dates for the midterm exams are September 28, October 26, and November 23.** They will be available online on those days. The duration of each midterm will be 60 minutes. The exam will be available on Canvas under "Assignments" for 24 hours on the day is scheduled (from 12:01 am to 11:59 pm). The moment you start the exam you will have 60 minutes to complete it. The solutions for the exam problems will be available after the due date/time and after the exam are graded.

Final exam: A final exam will be given online during finals week. **The final exam is scheduled for Wednesday, December 16th.** The exam will be available on Canvas under "Assignments" for 24 hours on the day is scheduled (from 12:01 am to 11:59 pm). The duration of the final exam will be 120 minutes. The moment you start the exam you will have 120 minutes to complete it. The solutions for the exam problems will be available after the due date/time and after the exam are graded.

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.

The dates of the exams during the semester are subject to change and will be announced on Canvas 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.

Lecture materials and recordings for PHYS 384 are protected intellectual property at UW-Stevens Point. Students in this course may use the materials and recordings for their personal use related to participation in this class. Students may also take notes solely for their personal use. If a lecture is not already recorded, you are not authorized to record my lectures without my permission unless you are considered by the university to be a qualified student with a disability requiring accommodation. [Regent Policy Document 4-1] Students may not copy or share lecture materials and recordings outside of class, including posting on internet sites or selling to commercial entities. Students are also prohibited from providing or selling their personal notes to anyone else or being paid for taking notes by any person or commercial firm without the instructor's express written permission. Unauthorized use of these copyrighted lecture materials and recordings constitutes copyright infringement and may be addressed under the university's policies, UWS Chapters 14 and 17, governing student academic and non-academic misconduct.

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://www.uwsp.edu/veteran-services/Pages/Call-Up-Guidelines.aspx>.

Equal Access for Students with Disabilities:

Students with special needs should contact the Office of Disability Services as soon as possible (<http://www.uwsp.edu/disability/Pages/default.aspx>) 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 his/her disability. *If modifications are required due to a disability, please inform the instructor and contact the Disability and Assistive Technology Center to complete an Accommodations Request form. Phone: 346-3365 or Room 609 Albertson Hall.*

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.

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
- Planck'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