

Fall 2020
Physics 171: Planetary & Stellar Astronomy

Syllabus

MWF 9:00-9:50 am

RSOF: Predominantly remote and predominantly synchronous off-campus

Undergraduate prerequisites: None ... interest in space & the natural world.
(Necessary math skills: algebra, trigonometry.)

Instructors

Prof. Seth Aubin

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Peiwen Liu

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Office hours: Aubin: MWF 9:15-10:30 and by appointment.

Liu: by e-mail or appointment (Zoom).

Course Objectives

The primary purpose of this course is to introduce the basic concepts, science, and methods in planetary and stellar astronomy. The course will cover the following topics:

- Basic physics: motion, gravity, light, matter, fusion, tidal forces.
- The night sky: constellations.
- Spectroscopy: identifying atoms and molecules from their light.
- Astronomy instruments: telescopes and space probes.
- Solar system: Sun, planets, moons, asteroids, and comets.
- Exo-planets (astrobiology?).
- Main sequence stars, stellar evolution.
- Specials stars: dwarfs, Cepheids, neutron stars, black holes.
- Exploding stars: novae, supernovae, mergers.

Course Materials

Text: Most of the course materials and problem sets will be taken from the following required text for the course:

Astronomy by A. Fraknoi, D. Morisson, and S. C. Wolff, OpenStax (Rice U.), 2020.

→ Download for free at <https://openstax.org/details/books/astronomy>

Course Delivery Structure

The course will primarily be delivered on-line in a remote asynchronous manner. However, at 9:00-9:15 am MWF, I will work a problem synchronously via Zoom followed by a question & answer period. Students are expected to attend the Zoom problem session and to have already watched the on-line video lecture for that day. After this problem solving session, I will have office hours until 10:30 am.

The course lectures will be posted on the Blackboard course site before the class meeting time (typically several days before).

Evaluations

Your final grade for the course will be determined from the following grading weight distribution:

Participation:	10%
Problem sets:	20%
Papers & Presentation:	25%
Midterms (3):	25%
Final Exam:	20%

Participation: The video lectures of course material will involve quizzes at the end of each video. They are intended to be a quick knowledge check and are not intended to be difficult. Points for each quiz will be assigned in the following manner: 2 points for a correct answer, 1 point for a wrong answer, and 0 points for not taking the quiz. The course will feature at least one worked problem at each class meeting time, followed by a question and answer period. Students are expected to attend these short problem sessions and ask questions. Participation reflects attendance, questions, and quiz performance.

Problem sets: The problem sets are the main method for learning the course material. Students are expected to do the problems on their own (not as a team effort with other students), though discussion and limited “verbal” (oral/texting/e-mail) consultation with other students is encouraged (but not numerical equation-based discussion). The solution manual for the main text or solution sets from past courses are not acceptable sources for solving problem sets before they are due.

There will be weekly problem sets (roughly 3-5 problems). A random selection of 1-3 of these problems will be graded. You can also expect these problems to be selected for quizzes and midterm tests. If the class is large, then we may switch to an on-line grading system such as WebAssign.

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Papers & Presentation: The course features two interludes (weeks 8 & 12) during which we will investigate a broad topic that reaches out to other academic domains, i.e. Cultures, Societies, and Individuals (CSI) and Arts, Letters, and Values (ALV). Students will write up short papers (4-5 pages) on the interlude topics and will participate in a team presentation for interlude I.

Interlude I: Humanity in the Solar System. Topics related to “colonizing” Earth orbit, the Moon, asteroids, and nearby planets.

Interlude II: Space Art. Imagining other worlds. Space in still art and movies.

Midterms: There will be two midterm tests, each worth 10% of your overall final grade. The midterms will be conducted remotely (probably using Gradescope and HonorLock).

Final exam: The final exam will cover all the material in the course. The final exam will be conducted remotely (probably using Gradescope and HonorLock).

E-mail policy

Feel free to communicate with S. Aubin or P. Liu via e-mail. We cannot guarantee that we will read e-mails sent in the evening until the next day.

Additional hours due to shortened semester

The semester has been shortened by one week, so a total of three hours must be added to the allotted teaching time. Each lecture period will feature videos (and Q&A period) whose combined length is a little longer than the 50 minutes allotted for that time. This additional time will consist of about 4 extra minutes per lecture (on average).

Important academic deadlines

***Add/drop deadline: Friday, August 28, 2020**

****Withdraw deadline: Monday, October 12, 2020**

Weekly Schedule (tentative)

Week 0: 8/19-21 **Intro to Astronomy [Ch. 1, 2]**

Overview, units, distance scales, time, atoms to galaxies, radius of the Earth.

Week 1: 8/24-28* **Basic Physics I: Motion and Orbits [Ch. 3]**

Constellations, gravity, orbits, Kepler's laws, seasons, precession.

Week 2: 8/31-9/4 **Basic Physics II: Newton and Gravity [Ch. 3]**

Kepler's laws, Galileo, Newton's laws, conservation laws, gravity, circular motion, tides.

Week 3: 9/7-11 **Basic Physics III: Light and Matter [Ch. 5, 16.1-2]**

Electromagnetic waves, blackbody radiation, photons, atoms, fusion, Doppler effect.

Week 4: 9/14-18 **Astronomy Instruments [Ch. 6]**

MIDTERM #1. Telescopes, resolution, adaptive optics, interferometry, space probes.

Week 5: 9/21-25 **Solar System I: Overview [Ch. 7, 21]**

Structure of solar system, planetary density, formation of solar system, radio-dating.

Week 6: 9/28-10/2 **Solar System II: Earth & Rocky Planets [Ch. 8, 9, 10]**

Planetary structure, magnetosphere, atmosphere, tidal locking, Mercury, Venus, Mars.

Week 7: 10/5-9 **Solar System III: Gas Giants [Ch. 11, 12]**

Planetary structure, Jupiter and Galilean moons, Saturn and rings, Uranus, Neptune.

Interlude I: Humanity in the Solar System (presentation + paper).

Week 8: 10/12-16** **Dwarf Planets, Comets, Exoplanets, Life [Ch. 13, 14, 30]**

Outer solar system, asteroids, comets, exo-planet hunting, exo-life.

Week 9: 10/19-23 **Stars I: Our Sun & Main Sequence Stars [Ch. 15, 16, 17]**

MIDTERM #2. Structure, solar wind, sunspots, fusion, star brightness and temperature.

Week 10: 10/26-30 **Stars II: Stellar Evolution [Ch. 17, 18, 19, 22]**

Luminosity vs mass, H-R diagram, spectroscopy, star types.

Week 11: 11/2-6 **Stars III: Stellar Death [Ch. 22, 23]**

Helium fusion and beyond, red giants, white dwarfs, novae, supernovae, neutron stars.

Interlude II: Space Art (presentation + paper).

Week 12: 11/9-13 **Black Holes & Einstein's Relativity [Ch. 24]**

Special & general relativity, spacetime, gravitational redshift, black holes.

----- Classes Finish -----

Nov 20, 2020, 9am-noon **Final Exam**

Piazza Q&A forum

We will use Piazza.com as a forum for questions & answers. You will receive an invitation to enroll by e-mail.

HonorLock

The course will use HonorLock for proctoring the midterms and final exam.

Student Accessibility Services

William & Mary accommodates students with disabilities in accordance with federal laws and university policy. Any student who feels that's/he/they may need an accommodation based on the impact of a learning, psychiatric, physical, or chronic health diagnosis should contact Student Accessibility Services staff at 757-221-2512 or at sas@wm.edu to determine if accommodations are warranted and to obtain an official letter of accommodation. For more information, please see www.wm.edu/sas.

Honor Code (from W&M website)

William & Mary has had an honor code since at least 1779. Academic integrity is at the heart of the university, and we all are responsible for upholding the ideals of honor and integrity. The student-led honor system is responsible for resolving any suspected violations of the Honor Code, and I will report all suspected instances of academic dishonesty to the honor system. The Student Handbook (www.wm.edu/studenthandbook) includes your responsibilities as a student. Your full participation and observance of the Honor Code is expected. To read the Honor Code, see www.wm.edu/honor.

Academic dishonesty includes cheating, plagiarism, unauthorized collaboration, and use of unauthorized materials.