NORTHERN ARIZONA UNIVERSITY | College of Engineering, Forestry, and Natural Sciences

Astrophysics: The Solar System

This syllabus is a general guide to the semester. However, please bear with me as things will likely change throughout the semester. If there are things that I can help with, issues you are having regarding the course, or if you see something that would improve the dissemination of course material, please don't wait until the end of the semester to bring them up, as I want to make this course as beneficial to you as possible.

General Information

- Department: Astronomy and Planetary Science
- Course: AST-390 (Astrophysics: The Solar System) – Class Number 6183 Section 001
- Term: Spring 2021
- Total Units of Course Credit: 3
- Pre- and Co-Requisite(s): AST-280, PHY-263 and MAT-137
- Mode of Instruction: Face-to-Face (prior to COVID)
- Meeting Time: Tuesday/Thursday 12:45 - 2:00 p.m.
- Location: Physical Sciences (Bldg 19) 233
- Instructor: Mark Loeffler
- Phone: 928-523-0369; Email: Mark.Loeffler@nau.edu
- Address for Office Hours (Zoom-same as class link)
- Office Hours: Tuesday 11:40 – 12:40 p.m. and Thursday 2:00 – 3:00 p.m. and by appointment

Course Description

This course covers the physical processes governing the origin and evolution of the Solar System and the objects within it. Extrasolar planetary systems also are discussed.

Course Learning Outcomes

By the end of the semester, you should be able to

(a) Apply concepts from physics, astronomy, chemistry, and geology to solve problems in planetary science.
(b) Describe the structure of the solar system and the major characteristics of terrestrial planets, giant planets, dwarf planets, and small solar system bodies.
(c) Describe how planetary interiors, surfaces, atmospheres, and/or magnetospheres evolve and interact to produce the features seen today on solar system bodies.
(d) Describe the techniques utilized to detect extrasolar planetary systems.

(e) Understand enough planetary science to be able to comprehensively read professional papers in journals such as *Icarus, Journal of Geophysical Research—Planets, Science*, and *Nature*.

Assessment

Homework: Quantitative homework assignments are distributed throughout the semester. You may work with other people in the class on the assignments, but each student must turn in his/her own work. Homework which is copied, xeroxed, or suspiciously similar to others will receive a zero. Homework is due (i.e. should be uploaded) at the beginning of class on the day specified—25% will be deducted for *each working day* (i.e., Monday through Friday) that the homework is late, up to one week past the due date. No homework will be accepted once solutions are posted on BBLearn. Homework is 30% of your grade.

Exams: There will be two semester exams (each worth 20% of your grade) and a final exam (30% of your grade). Exams will consist of a combination of qualitative and quantitative questions. *The final exam will be comprehensive*. Makeup exams are not given except in extreme circumstances (hospitalization; death of a close family member; etc.) and I **must** have written documentation of the emergency before the exam. ***All work on the exams must be done individually. The final exam is comprehensive and everyone must take it at the scheduled time during finals week.***

Grades:
Final grades in the class will be computed from the following:

Homework: 30%
Exam 1: 20%
Exam 2: 20%
Final Exam: 30%

At the end of the semester, I will take a weighted average of your assignments and assign a grade based on the following grading scale:

90% - 100%	A
80% - 89%	B
70 – 79%	C
60 – 69%	D
<59%	F

This is the guaranteed grading scale. I reserve the right to lower the curve but I will not raise it. Also, the way tests and homework are administered may be somewhat fluid, but I will communicate with you continually throughout the semester in regards to these items.

Required Materials

There is no required textbook for this class. Chapter readings will be posted on Blackboard Learn. For an extra source besides the class readings, I suggest Fundamental Planetary Science by J.J. Lissauer and I. de Pater (ISBN-10: 052161855X; ISBN-13: 978-0521618557).

Academic Honesty

Please read this section carefully as each student is required to understand and comply with all Academic Integrity rules and standards. Both NAU and this Department//Course have standards which are written and referenced below.

Both myself and the science/engineering profession have absolutely no patience with cheating. Anyone cheating on an exam will receive a zero on that exam, and possibly a failing grade in the course. Passing other's work off as your own (plagiarism) and cheating are not accepted at NAU and are not tolerated in my class. If I catch you cheating or if I find assignments/exams which are suspiciously similar (such as exact same wording on written responses—note, changing a few words or the order of certain words is still plagiarism!), all students involved will receive zero points on that assignment or exam. I don't care who cheated off whom—everyone involved gets the same score of zero. If cheating/plagiarism continue, you will receive an F in the class and the Dean's office will be notified. The bottom line: ***Do your own work and don't let others copy off of you.***

Note that no student will be allowed to exit the classroom during any of the exams (assuming we take exams in class), unless there is an emergency. Therefore, make sure you get a drink and visit the facilities in advance. If you feel that you might need to leave the classroom during an exam, you must get advance permission from the professor, in writing (email), before the exam. The use of cell phones at any time during an exam will be considered an act of academic dishonesty. The same holds true for smart-watches and "Google Glasses", or other enhanced vision products. You must not use or look at or touch your phone or watch (even if not a smart watch) at any time. You will be asked to place all such products securely away, out of reach and view, before the exam begins. You are not allowed to use your phone as a calculator. The same holds true for any calculator that can communicate with any other device or user. You may not bring in any paper to any exam, including "cheat sheets", and you may not take any paper out of the classroom after any exam. You are not allowed to look at the exam of another student, nor are you allowed to send or receive any information and/or signals or other forms of communication during an exam. The violation of any of these Academic codes of conduct may result in your failing the course.

In general, it is not my responsibility to attempt to describe and prohibit any and all forms of Academic Dishonesty. **It is your responsibility to uphold the highest ethical standards**. If you have any doubt or question about this policy, it is your responsibility to ask the professor in advance and to be clear about the answers and policies. Again, the text above and the attached NAU policies try to be very clear about what constitutes an act of Academic Dishonesty, but we cannot anticipate every possible form of cheating in advance. So the attachments and examples above are not meant to be comprehensive.

Academic Dishonesty information will be given to the Dean of Students and a written copy of any such incident may be attached to your official NAU file.

COVID-19 REQUIREMENTS AND INFORMATION

The following statements in red set forth in this document's first section are specific to NAU's response to the COVID-19 situation. The requirements outlined below are mandatory until further notice. They are based upon current public health conditions and guidance and may change as circumstances warrant or new information becomes available. Additional information about the University's response to COVID-19 is available from the **Jacks are Back!** web page located at https://nau.edu/jacks-are-back/lumberjack-responsibilities.

FACE COVERING AND PHYSICAL DISTANCING REQUIREMENTS

Appropriate face masks or other suitable face coverings must be worn by all individuals when present in classrooms, laboratories, studios, and other dedicated educational spaces. To maximize the benefits of physical distancing as an important strategy to help reduce community transmission of the SARS-CoV-2 virus, instructors may implement mandatory student seating arrangements or specific seat assignments. Instructors may remove students who do not cooperate with these requirements from the instructional space in the absence of an approved accommodation arranged through Disability Resources. Failing to comply with these requirements may constitute a violation of the university's *Disruptive Behavior in an Instructional Setting* policy available at https://nau.edu/university-policy-library/disruptive-behavior.

USE NAUFLEX TO HELP MAINTAIN PHYSICAL DISTANCING

NAUFlex (available at https://nau.edu/nauflex/student) is designed to help all students actively participate in their coursework during the required day and time of a course when they are not physically present in the classroom. This course design model allows students to be fully engaged with faculty and peers and receive the high-quality educational experience for which NAU is known.

CLASS SESSION RECORDINGS FOR STUDENTS AND FACULTY USE ONLY

Certain class sessions may be audio or video recorded to help reinforce live instruction during the COVID-19 pandemic. These recordings are for the sole use of the instructor and students enrolled in the course. Recordings will be stored in approved, accessible repositories. By enrolling, students agree to have their image and classroom statements recorded for this purpose, to respect the privacy of their fellow students, and university-owned intellectual property (including, but not limited to, all course materials) by not sharing recordings from their courses. Questions regarding restrictions on the use of classroom audio or video recordings may be addressed to the appropriate academic unit administrator.

Other Important University and Course Policies:

Academic Integrity: NAU expects every student to firmly adhere to a strong ethical code of academic integrity in all their scholarly pursuits. The primary attributes of academic integrity are honesty, trustworthiness, fairness, and responsibility. As a student, you are expected to submit original work while giving proper credit to other people's ideas or contributions. Acting with

academic integrity means completing your assignments independently while truthfully acknowledging all sources of information, or collaboration with others when appropriate. When you submit your work, you are implicitly declaring that the work is your own. Academic integrity is expected not only during formal coursework, but in all your relationships or interactions that are connected to the educational enterprise. All forms of academic deceit such as plagiarism, cheating, collusion, falsification or fabrication of results or records, permitting your work to be submitted by another, or inappropriately recycling your own work from one class to another, constitute academic misconduct that may result in serious disciplinary consequences. All students and faculty members are responsible for reporting suspected instances of academic misconduct. All students are encouraged to complete NAU's online academic integrity workshop available in the E-Learning Center and should review the full academic integrity policy available at https://policy.nau.edu/policy/policy.aspx?num=100601.

Disruptive Behavior: Membership in NAU's academic community entails a special obligation to maintain class environments that are conductive to learning, whether instruction is taking place in the classroom, a laboratory or clinical setting, during course-related fieldwork, or online. Students have the obligation to engage in the educational process in a manner that does not breach the peace, interfere with normal class activities, or violate the rights of others. Instructors have the authority and responsibility to address disruptive behavior that interferes with student learning, which can include the involuntary withdrawal of a student from a course with a grade of "W". For additional information, see NAU's disruptive behavior policy at https://nau.edu/university-policy-library/disruptive-behavior.

Nondiscrimination and Anti-Harassment: NAU prohibits discrimination and harassment based on sex, gender, gender identity, race, color, age, national origin, religion, sexual orientation, disability, or veteran status. Due to potentially unethical consequences, certain consensual amorous or sexual relationships between faculty and students are also prohibited. The Equity and Access Office (EAO) responds to complaints regarding discrimination and harassment that fall under NAU's Safe Working and Learning Environment (SWALE) policy. EAO also assists with religious accommodations. For additional information about SWALE or to file a complaint, contact EAO located in Old Main (building 10), Room 113, PO Box 4083, Flagstaff, AZ 86011, or by phone at 928-523-3312 (TTY: 928-523-1006), fax at 928-523-9977, email at equityandaccess@nau.edu, or via the EAO website at https://nau.edu/equity-and-access.

Title IX: Title IX is the primary federal law that prohibits discrimination on the basis of sex or gender in educational programs or activities. Sex discrimination for this purpose includes sexual harassment, sexual assault or relationship violence, and stalking (including cyber-stalking). Title IX requires that universities appoint a "Title IX Coordinator" to monitor the institution's compliance with this important civil rights law. NAU's Title IX Coordinator is Pamela Heinonen, Director of the Equity and Access Office located in Old Main (building 10), Room 113, PO Box 4083, Flagstaff, AZ 86011. The Title IX Coordinator is available to meet with any student to discuss any Title IX issue or concern. You may contact the Title IX Coordinator by phone at 928-523-3312 (TTY: 928-523-1006), by fax at 928-523-9977, or by email at pamela.heinonen@nau.edu. In furtherance of its Title IX obligations, NAU will promptly investigate and equitably resolve all reports of sex or gender-based discrimination, harassment, or sexual misconduct and will eliminate any hostile environment as defined by law. Additional important information about Title IX and related student resources, including how to request

immediate help or confidential support following an act of sexual violence, is available at http://nau.edu/equity-and-access/title-ix.

Accessibility: Professional disability specialists are available at Disability Resources to facilitate a range of academic support services and accommodations for students with disabilities. If you have a documented disability, you can request assistance by contacting Disability Resources at 928-523-8773 (voice), 928-523-6906 (TTY), 928-523-8747 (fax), or dr@nau.edu (e-mail). Once eligibility has been determined, students register with Disability Resources every semester to activate their approved accommodations. Although a student may request an accommodation at any time, it is best to initiate the application process at least four weeks before a student wishes to receive an accommodation. Students may begin the accommodation process by submitting a self-identification form online at https://nau.edu/disability-resources/student-eligibility-process or by contacting Disability Resources. The Director of Disability Resources, Jamie Axelrod, serves as NAU's Americans with Disabilities Act Coordinator and Section 504 Compliance Officer. He can be reached at jamie.axelrod@nau.edu.

Course Time Commitment: Pursuant to Arizona Board of Regents guidance (Academic Credit Policy 2-224), for every unit of credit, a student should expect, on average, to do a minimum of three hours of work per week, including but not limited to class time, preparation, homework, and studying.

Sickness or Hospitalization: Northern Arizona University has an official authorized absence policy that is administered by the Office of Student Life. Institutional excuses can be issued to authorize absences. If a student is hospitalized or has been directed by a physician to remain confined to his or her place of residence because of illness, Fronske Health Center staff or private physicians may issue a statement providing the dates of the student's confinement.

AST-390 ASTROPHYSICS: THE SOLAR SYSTEM
SPRING 2021
Tentative Schedule (SUBJECT TO CHANGE)

DATE	TOPIC	READING
Jan. 12	Kepler's & Newton's Laws	Ch. 1.1-1.2
Jan. 14	Newton's Laws/Orbits	Ch. 1.2-1.5
Jan. 19	Tides	Ch. 1.6
Jan. 21	Planetary System Formation	Ch. 2.1
Jan. 26	Solar System Structure	Ch. 2.2
Jan. 28	Exoplanets	Ch. 2.3
Feb. 2	Planetary Interiors: Seismology	Ch. 3.1.1
Feb. 4	Planetary Interiors: Heat Flow	Ch. 3.1.2
Feb. 9	Planetary Interiors: Gravity	Ch. 3.1.3
Feb. 11	Planetary Magnetospheres	Ch. 3.2
Feb. 16	EXAM 1 (Chapters 1-3)	
Feb. 18	Planetary Temperatures	Ch. 4.1
Feb. 23	Planetary Atmospheres	Ch. 4.2.1-4.2.2
Feb. 25	Planetary Atmospheres	Ch. 4.2.2-4.2.4
Mar. 2	Planetary Surfaces	Ch. 4.3.1
Mar. 4	Planetary Surfaces	Ch. 4.3.2
Mar. 9	Planetary Surfaces	Ch. 4.3.2-4.3.3
Mar. 11	Planetary Surfaces	Ch. 4.3.3
Mar. 16	Asteroids	Ch. 5.1
Mar. 18	Meteoritic Material	Ch. 5.2
Mar. 23	Comets	Ch. 5.3
Mar. 25	IDPs & Solar Wind	Ch. 5.4-5.5
Mar. 30	Terrestrial Planets	Ch. 6.1-6.2
Apr. 1	Terrestrial Planets	Ch. 6.2-6.3
Apr. 6	Terrestrial Planets	Ch. 6.4-6.5
Apr. 8	EXAM 2 (Chapters 4-6)	
Apr. 13	Giant Planets	Ch. 7.1-7.2
Apr. 15	Giant Planets	Ch. 7.2-7.3

Apr. 20	Giant Planets	Ch. 7.4-7.5
Apr. 22	Dwarf Planets	Ch. 8
April 27	**FINAL EXAM 12:30-2:30 PM** (Chapters 1-8)	

University Academic Deadlines:

January 10: Last Day to Add without late fee
January 20: Last Day to Drop a class without it appearing on your transcript
January 25: Last Day to Drop with 100% refund
February 22-March 12: Mid-term grades submitted
March 14: Last Day to Withdraw from a course
April 15: Last day to withdraw from NAU (all classes)
April 26-April 29: Final Exams