

PTY5 505B - Principles of Planetary Physics

This class is scheduled to be taught in the in person modality.

Class Website

d2l.arizona.edu (student login required)

Instructor

Isamu Matsuyama

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(520) 621-4002, isamu@arizona.edu

Office hours

Please email me to arrange an in person or a remote meeting time

Class meetings

Wednesdays and Fridays, 12:30 PM - 1:45 PM, Kuiper Space Sciences Building, Room 312

Classroom attendance

- If you feel sick, or may have been in contact with someone who is infectious, stay home. Except for seeking medical care, avoid contact with others and do not travel.
- Notify your instructor if you will be missing a course meeting or an assignment deadline.
- Non-attendance for any reason does not guarantee an automatic extension of due date or rescheduling of examinations/assessments.
- Please communicate and coordinate any request directly with your instructor.
- If you must miss the equivalent of more than one week of class, you should contact the Dean of Students Office DOS-deanofstudents@email.arizona.edu to share documentation about the challenges you are facing.
- Voluntary, free, and convenient COVID-19 testing is available for students on Main Campus.
- COVID-19 vaccine is available for all students at Campus Health.
- Visit the UArizona COVID-19 page for regular updates.

Objectives and expected learning outcomes

The students will develop a broad understanding of the importance of physical processes that shape planetary systems. For example, they will acquire a quantitative understanding of the two-body problem, Kepler's laws of motion, planet formation by core accretion and gravitational instability, rotational and tidal distortions, and energy dissipation. At the end of the course, students will know how to derive Kepler's laws of motion by solving the two-body problem; understand the dynamical origin and evolution of planetary systems; and understand the physical processes that shape planetary interiors.

Textbook

There is no required textbook. The following textbooks are recommended:

- [An introduction to Planetary Physics, Kaula](#)

- [Solar System Dynamics, Murray and Dermott \(Errata\)](#)
- [Planetary Sciences, de Pater and Lissauer](#)
- [Lecture notes on the formation and early evolution of planetary systems, Armitage](#)

Copies of these books are on reserve at the LPL library (Kuiper Space Sciences 409) and are also available for in-library use in the UA Library's Special Collections.

Class format

Class meetings will generally be built around reading assignments. Students are expected to be prepared with the material assigned prior to each class. We will use a combination of traditional lectures, open discussions and student-led presentations, according to topic and material. Although no formal attendance record will be made, class participation will be part of the grade, and homework assignments are likely to make more sense if you've been to class.

Grading

The grades will be on an A (90% and higher), B (80-89%), C (70-79%), D (60-69%), E (59% and lower) scale, and will be based on three components: class participation (25%), randomly collected homework assignments (25%) and three exams (50%, 16.7% each).

Due dates, late work, absences

Assignments are due in class on the due date. I would rather have late work than no work, although you should expect it to be for reduced credit. If you anticipate an absence on the due date of an assignment, please either turn in your work early or discuss alternative arrangements with me.

Academic integrity

You are expected to know and to abide by the [University's Academic Integrity policy](#). Two primary points you need to know are these: (1) When you turn in (or present) work that uses published material (journal articles, web sites, etc.), you are expected to give the appropriate credit and cite the source(s). (2) Collaboration is encouraged on most assignments, as I strongly believe that we learn more by asking questions and explaining our answers to others' satisfaction. However, if you do work with someone, the work you turn in for grading must be written by you *in your own words*; if I get identical answers, I will divide the credit evenly.

Students with Disabilities

If you anticipate barriers related to the format or requirements of this course, please meet with me so that we can discuss ways to ensure your full participation in the course. If you determine that disability-related accommodations are necessary, please register with Disability Resources (621-3268; <http://drc.arizona.edu>) and notify me of your eligibility for reasonable accommodations. We can then plan how best to coordinate your accommodations.

Other classroom issues

We try to keep the classroom clean, and ask for your help. Please do not bring any food or drink (other than bottled water) into the classroom. If there are problems with a seat or with its writing table, please let me know, so that the problems can be addressed as soon as possible. Also, the common-sense rules of good conduct apply, such as cell phones turned off and no web-surfing or irrelevant extra-curricular activity during class.

Notice

The information contained in this course syllabus, other than the grade and absence policies, may be subject to change with reasonable advance notice, as deemed appropriate by the instructor.

Topics Covered

- **Celestial mechanics:** the two-body problem, the three-body problem.
- **Protoplanetary disks:** observations, MMSN, vertical structure, radial force balance, surface density evolution.
- **Planetesimal formation:** aerodynamic drag, planetesimal formation by coagulation, planetesimal formation by gravitational instability.
- **Terrestrial planet formation:** time scale for formation, gravitational focusing and the Safronov number, Impulse approximation.
- **Giant planet formation:** core accretion, envelope structure, gravitational instability.
- **Planet migration:** in gaseous disks in planetesimal disks.
- **Spherical planets in hydrostatic equilibrium:** equation of state, polytropes, relation between pressure-density and mass-radius.
- **Static distorted planets:** spherical harmonic representations, gravity anomalies, moments of inertia.
- **Rotational distortion:** Maclaurin and Jacobi theory, Radau-Darwin approximation.
- **Tidal distortion:** tides, hydrostatic response, Love numbers.
- **Rigid-body motion:** moment of inertia tensor, angular momentum of a rigid body, Euler's equations, effect of dissipation.
- **Energy sources in planets:** gravitational binding energy, thermal energy, radioactivity, tidal dissipation.

Nondiscrimination and Anti-harassment Policy

The University of Arizona is committed to creating and maintaining an environment free of discrimination. In support of this commitment, the University prohibits discrimination, including harassment and retaliation, based on a protected classification, including race, color, religion, sex, national origin, age, disability, veteran status, sexual orientation, gender identity, or genetic information. For more information, including how to report a concern, please see: <http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy>

University Policies

All university policies related to a syllabus are available at: <https://academicaffairs.arizona.edu/syllabus-policies>.

Academic advising

If you have questions about your academic progress this semester, please reach out to your academic advisor (<https://advising.arizona.edu/advisors/major>). Contact the Advising Resource Center (<https://advising.arizona.edu/>) for all general advising questions and referral assistance. Call 520-626-8667 or email to advising@.arizona.edu

Life challenges

If you are experiencing unexpected barriers to your success in your courses, please note the Dean of Students Office is a central support resource for all students and may be helpful. The Dean of Students Office can be reached at (520) 621-2057 or DOS-deanofstudents@email.arizona.edu.

Physical and mental-health challenges

If you are facing physical or mental health challenges this semester, please note that Campus Health provides quality medical and mental health care. For medical appointments, call (520) 621-9202. For After Hours care, call (520) 570-7898. For the Counseling & Psych Services (CAPS) 24/7 hotline, call (520) 621-3334.