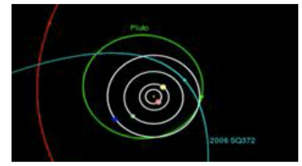
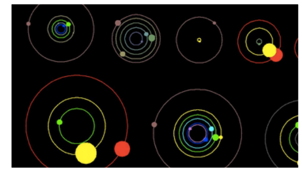
PTYS/ASTR 553 Solar System Dynamics

Syllabus





Spring 2024: Tues, Thur 2:00-3:15 p.m.
— Kuiper Space Sciences Building Room 312
— First meeting will be on January 11

Prof. Renu Malhotra
http://www.lpl.arizona.edu/~renu/
Kuiper Space Sciences 515; (520)626-5899; malhotra@arizona.edu
Office hours: Anytime I am around and not busy with something or someone else; for guaranteed time, please make an appointment.

Course Objectives: This course develops quantitative skills to analyze and understand the orbital motions of planets, moons, minor planets and dust complexes in planetary systems, both in our solar system and in extra-solar systems. There will be applications to natural phenomena related to the spacings and time variability of planetary orbits in the solar system and in exo-planetary systems, planet formation and migration, and stability, chaos and transport of asteroids and comets. The course is intended for beginning planetary science and astronomy graduate students; students from related disciplines are also welcome. Senior undergraduates may be able to enroll with permission of the instructor

Course Outcomes: Students will be able to apply the concepts and principles of orbital dynamics to draw conclusions and deduce implications from diverse observational data about planets and minor bodies in planetary systems.

Pre-requisite(s): Vector Calculus, Ordinary Differential Equations, Classical Mechanics. Students should also be (or become) proficient in a programming language and graphics software (examples: Fortran, C, Python, GnuOctave, Matlab).

Class Web Page: You will need a UA Net ID to access the class web page at the UA's D2L website, http://d2l.arizona.edu. I will use the class webpage to post class notes and assignments, and other communications. This webpage will be updated frequently throughout the semester.

Textbooks: Recommended: "Solar System Dynamics" by C.D. Murray and S.F. Dermott, Cambridge University Press, UK, 1999; "Dynamics of Planetary Systems" by Scott Tremaine, Princeton University Press, USA, 2023. Both books are available in hardcover, paperback and electronic book.

Grades: Regular letter grades are awarded for this course, with a default grading scale of:
A — 85-100%, B — 70-84%, C — 55-69%, D — 40-54%, E — 0-39%. The instructor reserves the right to adjust the grade boundaries based on her expectations of student performance.

There will be weekly homework assignments; late work will be accepted with prior agreement of the instructor. A random selection of approximately 50% of the assignments will be graded over the course of the semester. The final exam will be comprehensive; it will be open notes, textbook and calculators permitted. Grades will be based on the greater of: the final exam or the average of the final exam and the graded homework assignments.

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UA Academic Policy notice: The University's policies are posted at https://academicaffairs.arizona.edu/syllabus-policies. I expect students to be ethical, to be cognizant of and to abide by the relevant policies on (i) academic integrity, (ii) classroom behavior and (iii) the use of University resources.

Subject to Change Statement: The workload and course requirements other than the grading policy are subject to change at the discretion of the instructor with reasonable notice to the students.

Approximate schedule of topics:

- Introduction - phenomenology
- Two body problem [3 weeks]
- Numerical methods [2 weeks]
- Three body problem [3 weeks]
- N-planet problem [5 weeks]
  - coordinate systems
  - the disturbing function
  - secular perturbations
  - resonant perturbations
  - stability of multi-planet systems
  - planet migration
- Planetary spins [1 week]
- Tides [1 week]