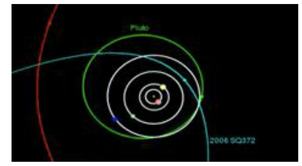
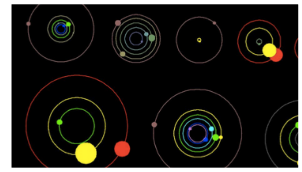
PTYS/ASTR 553 Solar System Dynamics

Syllabus [draft]





Spring 2022: Tues, Thur 9:30-10:45 a.m.
– Kuiper Space Sciences Building Room 330
First meeting will be on January 13

Prof. Renu Malhotra
http://www.lpl.arizona.edu/~renu/
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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.

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.

Textbook: "Solar System Dynamics", by C.D. Murray and S.F. Dermott, Cambridge University Press, UK, 1999. It is available in hardcover, paperback and electronic book. Upon enrolling in this course, a student automatically has access to the electronic book through the UA; for cost and access information, please carefully read "Syllabus Inclusive Access Information" posted on the class webpage at D2L.

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; 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.

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

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

Approximate schedule of topics:

- Introduction - phenomenology [1 week]
- 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
- Planetary spins [1 week]
- Tides [1 week]