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

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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.

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]