Syllabus for ASTR 5622.2: Astrophysical Dynamics

Class time: TTh 11:30am–12:45.
Class room: MM310
Instructor: Dr. Joseph M. Hahn
Office: MM301-B
Office hours: 3–4pm on MW and 1–2pm on F
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Texts:

Lectures are loosely based upon *Solar System Dynamics* by Murray & Dermott, and *Galactic Dynamics* by Binney & Tremaine. Lecture notes will be posted at the above URL.

Grading:

33.3% for assignments
33.3% for midterm exam
33.3% for final exam

Course Content:

2–body problem:

Review Newton's & Kepler's laws, orbital motion

3–body problems:

motion in a rotating reference frame, Jacobi integral, Lagrange points, tadpole & horseshoe orbits, Hill's equations, Hill sphere & Roche limit, epicyclic motion

Perturbed motion:

Gauss' planetary equations, effects of planetary oblateness, resonances, shepherding

Circumstellar disks & planetary rings:

equilibrium disk configuration, orbit decay due to gas drag, resonance trapping, hydrodynamics of a disk, viscous evolution

Spiral wave theory:

gravity waves in planetary rings and galactic disks, pressure waves in circumstellar disks, type I & II planet migration

Stability analysis:

Jean's instability, sausage instability, stability of circumstellar disks

Evolution of galaxies and star clusters:
dynamical friction, relaxation and evaporation timescales

Expectations for the assignments:

Your solutions to the assignments should be written in a manner that demonstrates that you understand each problem and its answer. Provide some commentary along with any math to explain key steps in your solutions. Also provide sketches as needed to illustrate your solution. All sketches should be large, easily understood at a glance, and well annotated. Keep in mind that hard–to–understand solutions will score low.

A good starting point for your homework derivations will be any of the equations given in the lecture notes. You are also free to use other equations you find in other sources: the class texts, other texts and websites, etc. *However, if you invoke an alternate formula not already derived in the lecture notes, your solution must also provide an accompanying derivation of that formula.* This exercise is designed to prevent students from relying on formulas that they have not proven to themselves, or that are otherwise unfamiliar to me.

Feel free to discuss homework problems with your fellow students. But keep in mind that it is expected that each student will submit their own solutions written by their own hand in their own unique style. *Copied solutions are not evidence of a student's understanding, and both the copy as well as the source solutions will score very low.*

I tend to award lots of partial credit. Never leave any part of any assignment or exam question unanswered.

Assignments must be turned in on time; late homework will not be accepted, except for urgent medical or personal reasons.

It is recommended that you visit my office routinely to discuss the class, lectures, assignments, exam preparations, etc. But please make an appointment in advance if you wish to visit during non–office hours.