SYLLABUS for course ASTC25,

Title: Astrophysics of Planetary Systems, Winter/Spring 2018

Lectures: Thursdays 13-15 BV361 Tutorials: Thursdays 11-12 in BV361

NOTICE: THERE IS NO TUTORIAL ON THE FIRST DAY, 11 Jan 2018 !!!!

Calendar of Lectures (L) and tutorials (T)

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11 Jan  L1+2, ----
18 Jan  L3+4,   T1
25 Jan  L5+6,   T2
 1 Feb  L7+8,   T3
 8 Feb  L9+10,  T4
15 Feb  L11+12, T5
22 Feb  ----------    (reading week)
 1 Mar  L13+14, *** in-class midterm *** during tutorial
 1 Mar  L15+16, T6
 8 Mar  L17+18, T7
15 Mar  L19+20, T8
22 Mar  L21+22, T9  (last day to drop w/o acad penalty; not in transcript)
29 Mar  L23+24, T10
 6 Apr  ----------- (drop date, after this date course mark adds to GPA)
11 Apr  final exam session begins
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Notes:

This syllabus will have an up to date listing of due dates for assignments. Please download this file from time to time.

Numbers in square brackets suggest chapters in Chaikin et al. book.

1. Introduction to the subject of the course

2-3. Gravitational mechanics of planetary systems
[cf. chapter 2, Carroll & Ostlie's book on our aux. course page]
* Gravitational 2-body interaction
* Kepler's laws with derivations
* The 2-body problem and the elliptic motion: E, L, vs. a, e

4. Elements of celestial mechanics I
* Tides in the solar system
* Disruption of satellites: the Roche limit

5-6. Elements of celestial mechanics II
* Precession of orbits and spin axes
* Theory of perturbations versus numerical computations
* Restricted 3-body problem and the Hill problem

7-8. Orbits beyond the elliptic ones
* Stability of motion
* Lagrange points and in disk
* Orbital resonances and chaos
* The future of our solar system

9-10. Formation of disks and stars
* Giant molecular clouds
* Jeans instability of protostellar cloud cores

* Opacity-limited fragmentation
* Simulations: the ubiquity of protostellar disks, brown dwarfs

11-12. Origins: Accretion disks
* Analogue disks: AGN/quasar disks, and their accretion
* Accretion disk geometry
* Disks as evolving, shearing flows

13-14. Formation od planets: the main scenarios [2,14]
* Accumulation versus fragmentation: two scenarios for the giants
* Gravitational stability of protoplanetary disks
* From dust to planetesimals

15. Formation od planets: early stages [2,14]
* From planetesimals to planetary cores: gravitational focusing
* Gravitational scattering of planetesimals into Oort cloud

16. Formation od planets: late stages [2,14]
* Isolation mass: a cause of giant impact epoch
* Late heavy bombardment
* Core-instability and gas accretion during formation of giant planets

17. Migration of protoplanets
* Migration as the reason for diversity
* Type 0 - by gas drag
* Type I - Lindblad torques
* Type II - after gap opening
* Type III - partially open gap

18. Meteoroids and dust in solar and extrasolar systems [23-26]
* Interplanetary dust: Zodiacal light disk and Brownlee particles
* Vega-type systems, replenished dusty disks of planetary systems
* Beta Pictoris disk: evidence of planetesimals and planets
* Dust processing & dust avalanches

19. Io, Europa, Titan - Satellites of giants (SMP)
* Comparison of surfaces and atmospheres
* The role of tidal heating
* Water oceans beneath the surface

19. Comets [5,24] (SMP?)
* Comets - icy dirtballs or dirty iceballs?
* Cometary reservoirs: Oort cloud, inner Oort cloud, Kuiper belt
* Halley, Hyakutake, Hale-Bopp, Holmes, and those not starting with H
* Where do Earths oceans come from?

20. Planetary orbital resonances (SMP)
* Mean motion resonances in the solar system
* Resonances - stable or unstable?
* Kirkwood gaps in asteroid belt
* Resonances in the Kuiper belt
* Resonances in extrasolar systems

20. Planetary rings [16] (SMP?)
* Saturn's rings
* Rings of the outer planets

22. Atmospheres of planets, p. 1. [13,15]
    * Equilibrium of atmospheres
    * Giant planet atmospheres and Jeans escape
    * Greenhouse effect

23. Asteroids, Planetoids (dwarf planets) [23,25]
    * Asteroid belt
    * Kuiper belt objects
    * Planetoids/dwarf planets: Eris and others

24. Astrobiology and SETI [27]
    * Life on Earth: local or non-local origins?
    * Life elswhere: Mars, Europa, moons of exoplanets?
    * Habitable zones
    * Drake's equation, SETI and the Fermi paradox
