

Jan 11, 22 23:46	syllabC25-2022.txt	Page 1/2
SYLLABUS for ASTC25, Winter 2022.		
Title: Astrophysics of Planetary Systems		
Lecturer: Prof. Pawel Artymowicz (pronounced PAvel ArtyMovich)		
URL for all course materials: http://planets.uts.utoronto.ca/~pawel/ASTC25		
Tutorials: Thursdays 12-13 [in HW 408 from Feb?] online zoom (no tutorial on day 1)		
Lectures: Thursdays 13-15 [in HW 408 from Feb?] online zoom meetings		
Assignments are due at 12:00 (beginning of tutorial). Submit via Quercus.		
Calendar of Lectures (L), Tutorials (T), Assignments (A):		
13 Jan	--	L1+2
20 Jan	T1	L3+4
27 Jan	T2	L5+6
3 Feb	T3	L7+8 A1
10 Feb	T4	L8
17 Feb	T5	L9 A2
24 Feb	--	(reading week)
3 Mar	T6	L10-11 (T6 = midterm, time: 12-13)
10 Mar	T7	L12-14
17 Mar	T8	L15+16 A3
24 Mar	--	L17-20
31 Mar	T9	L21+22
7 Apr	T10	L23+24 A4
April, FINAL EXAM: TBD		
Syllabus is subject to ongoing small changes. Please download weekly.		
Numbers in brackets = chapt. of the Lissauer-dePater textbook to read, preferably ahead of the lecture.		
1. Introduction to the subject and style of the course		
2-4. Gravitational mechanics of planetary systems		
* Gravitational 2-body interaction		
* Kepler's laws with derivations		
* The 2-body problem and the elliptic motion: E, L, vs. a, e		
5. Elements of celestial mechanics I		
* Tides in the solar system		
* Disruption of satellites: the Roche limit		
6-7. Elements of celestial mechanics II		
* Precession of orbits and spin axes		
* Theory of perturbations vs. numerical computations		
* Restricted 3-body problem and the Hill problem		
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 (ch. 15)		
* 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 (ch. 15)		
* Analogue disks: AGN/quasar disks, and their accretion		
* Accretion disk geometry		
* Disks as evolving, shearing flows		
13. Formation of planets: the main scenarios		
* Accumulation versus fragmentation: scenarios for the giants		
* Gravitational stability of protoplanetary disks		
* From dust to planetesimals		
14. Formation of planets: early stages (ch. 15)		

Jan 11, 22 23:46	syllabC25-2022.txt	Page 2/2
* From planetesimals to planetary cores: gravitational focusing		
* Gravitational scattering of planetesimals into Oort cloud		
15.	Formation of planets: late stages (ch. 15)	
* Isolation mass: a cause of giant impact epoch		
* Late heavy bombardment		
* Core-instability and gas accretion onto giant planets		
16.	Meteoroids and dust in solar and extrasolar systems	
* 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		
16.	Asteroids, planetoids (dwarf planets)	
* Kirkwood gaps in asteroid belt		
* Asteroid belt		
* Kuiper belt objects and mechanics		
* Planetoids/dwarf planets: Eris and others		
* Classification of meteorites		
17.	Water in planetary systems	
* The H-comets		
* Comets - icy dirtballs or dirty iceballs?		
* Reservoirs: Oort cloud, inner Oort cloud, Kuiper belt		
* Halley, Hyakutake, Hale-Bopp, Holmes2		
* Where do Earth's oceans come from?		
17.	Planetary rings	
* Saturn's rings and gaps		
* Examples of satellites launching waves at resonances		
* Examples of satellites that open gaps		
* Rings as laboratory for disk-planet interaction		
18.	Irradiation instability of dusty disks	
* Dust avalanches		
* Role of optical thickness in instability		
* Numerical results		
19-20.	Exoplanet discovery	
* Methods: timing, radial vel., transits, microlensing, imaging		
* Overview of results and examples		
* chemical correlations		
21.	Atmospheres of planets and exoplanets	
* Equilibrium of atmospheres		
* Greenhouse effect		
* Effect of changing albedo		
22-23.	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		
24.	Astrobiology and SETI	
* Life on Earth: local or non-local origins?		
* Life elsewhere: Mars, Europa, moons of exoplanets?		
* Habitable zones		
* Drake's equation, SETI and the Fermi paradox		