SYLLABUS for course ASTB23 Stars, Galaxies & the Universe Fall 2018. The contents may slightly change as we go, and the syllabus updated.

Lectures: Thursdays 12:00-14:00 AA206. Tutorials: Thur. 17:00-18:00 AA206, (NOTICE: no tutorial after the first meeting!) Calendar od lectures (L1...L24) and tutorials (T1...T10) with remarks: <u>exam</u> 6. Sept

6 Sept. L1 + L2, 13 Sept. L3 + L4, T1 (last day to add/remove courses is 18 Sept) 20 Sept. L5 + L6, T2 27 Sept L7 + L8, T3 <-- assignment set 1 due L9 + L10,4 Oct. Τ4 11 - no meetings, reading week L11 + L12, T5 <-- assig. set 2 & in-class midterm 18 Oct. during T5 25 Oct. L13 + L14, T6 1 Nov L15 + L16, T7 L17 + L18, <-- assign. set 3 due 8 Nov. T8 (last day to drop courses w/o pen. is 15 Nov. L19 + L20, - -19 Nov) L21 + L22, 22 Nov. Τ9 29 Nov. L2302+4L234re6at 57410/4BDC < 0.060303000911.2 s0et6142 d7092 reW* nBT/F1 9.96 Tf 1 0 0 1 72 ?? Dec, <--- final exam [2 double-sided hand written sheets (not printed or photocopied), i.e. 4 pages of own notes are allowed at midterm, and 3 sheets (6p.) during the final exam Calculators are required. Books, phones, electronic devices not allowed.]

17. [2.3] Galactic rotation Infrared & radio view of the MIky Way Glactic bulge and Center (Nucleus) Measuring the Galactic rotation curve

18. Relaxation and evolution, part I
[3] The orbits of stars
[3.2] Why the Galaxy isn't bumpy: two-body relaxation, encounters Relaxation time: theory and the inferred histogram for globular

clusters

- 19. Relaxation and evolution, part II The virial theorem / Evaporation / mass segregation Effects of two-body relaxation: core collapse of globular clusters [3.x] Angular momentum and energy conservation in stellar motion Epicyclic theory of orbits in galactic potentials epicyclic frequecy, vertical frequency, azimuthal frequency and the corresponding periods
- 20. [4] Our backyard: the Local Group
 [4.2] Spirals of the Local Group
 The Andromeda galaxy / MB3: a late-type spiral
 [5] Spiral and SO galaxies
 [5.3] Gas motions and the masses of disk galaxies
- 21. Rotation Curves and Spiral Arms in Galaxies Decomposition of rotation curves. Two types of rotation curves. Dark matter in disk galaxies The Tully-Fisher versus the Faber-Jackson relationship [5.4] Spiral arms and galactic bars Observed spiral patterns: trailing vs. leading spirals Disk Dynamics and Spiral Structure Dispersion relation for gaseous disks Long waves / Short waves / Toomre stability of disks SWING amplifier Lin-Shu theory of spiral modes and WASER cycle Correlation of rotation curve with the type of spiral pattern: physical explanation of spiral galaxy classification
- 22. Bars as a by-product of spiral mode evolution Encounters and mergers between galaxies Gravitational lensing

23. [6] Elliptical galaxies
[6.2] Motions of the stars
The Faber-Jackson vs. Tully-Fisher relations
[6.5] Galaxy clusters: the domain of elliptical galaxies
Elliptical galaxies: nature, nurture, or merger?
[8] Supermassive Black Holes and Active Galactic Nuclei early history of galaxies

- 24. The Universe
 - [7] Large-scale distribution of galaxies
 - [7.1] Observations of large-scale structure: galaxy clustering
 - [7.2] Expansion of a homogeneous Universe
 - [7.3] Growth of structure: peculiar motions clusters, walls, and voids

[8.3] Cosmic Microwave Background Radiation (CMBR) - satellite observations.

First observational proof of a flat spacetime in our universe: Boomerag and WWAP experiments The universe in 21st century: Einstein's cosmological constant Lambda returns (Dark Energy)