ASTR400B Syllabus

Theoretical Astrophysics: Galaxies and Cosmology

Details:

Professor: Dr. Daniel Stark
Office: 318
email: dpstark [at] email.arizona.edu

Office hours: Time TBD based on student schedules, or by appointment.

Textbooks

1) Introduction to Cosmology, Second Edition (2017), B. Ryden
2) Galaxies in the Universe: An Introduction, Second Edition (2007), L.S. Spare & J.S. Gallagher

Grading:

Homework: 25%
Class Participation / Attendance: 15%
Midterms: 35%
Final Exam: 25%

Homework

Students should first attempt to solve problems on their own. Books and published papers may be consulted, but students should not look at old homework solutions or solutions of the problems that may be available online. Discussion of the problems with other students is permitted after students have tried the problems on their own. The submitted homework should represent each student's individual work. Homework will be submitted in class on the due date. Anything turned in after the due date will be considered late. Work turned in before the next class period will receive 75% credit. Work turned in two class periods following the due date will receive 50% credit. Work turned in more than two class periods late will not receive credit. Exceptions can be made for some extraordinary circumstances.

Midterms and Final Exam

There will be two closed book midterm examinations:

- February 21, 2019
- April 9, 2019

The final will also be closed book (some relevant equations and physical constants will be provided) and will take place on **Monday May 6** from 3:30 pm to 5:30 pm.

Class Participation / Attendance
This will be assessed through attendance, discussion/participation, and in-class activities. Please come to class ready to learn and engage with your peers. In order to ensure a productive learning environment for all students, please note the following rules:
1. Laptops, tablets, and cell phones must only be used for note taking.
2. Follow the University of Arizona Code of Academic Integrity

Students with disabilities who require reasonable accommodations to fully participate in course activities or meet course requirements are encouraged to register with the Disability Resource Center (http://drc.arizona.edu) and contact Dr. Stark to discuss accessibility issues.

Code of conduct: Students are expected to understand and follow the Student Code of Conduct, which is available at https://deanofstudents.arizona.edu/policies-codes.

Lecture Schedule (subject to change):

- Introduction fo Cosmology, fundamental observables
    - Reading: Ryden 1-2
- Describing curvature, Robertson-Walker metric, Friedmann Equation
    - Reading: Ryden 3-4.2
- Fluid and Acceleration equations, equation of state, cosmological constant
    - Reading: Ryden 4.3-4.5
- Model Universes I
    - Reading: Ryden 5.1-5.3
- Model Universes II
    - Reading: Ryden 5.4-5.5
- Measuring Cosmological Parameters I
    - Reading: Ryden 6.1-6.4
- Measuring Cosmological Parameters II, Nature of dark matter,
    - Reading: Ryden 6.5, 7.5
- Cosmic Microwave Background I
    - Reading: Ryden 8.1-8.3
- Cosmic Microwave Background II
    - Reading: Ryden 8.3-8.5
- Big Bang Nucleosynthesis and Early Universe
    - Reading: Ryden 9
- Inflation and Very Early Universe
    - Reading: Ryden 10
- Structure Formation I (gravitational instability in expanding universe)
    - Reading: Ryden 11.1-11.3
- Structure formation II (power spectrum, nature of dark matter, BAO)
    - Reading: Ryden 11.4-11.6
- Structure Formation: Baryons (first stars+quasars, reionization)
    - Reading: Ryden 12
- Introduction to Galaxies, Distances, Solar neighborhood, stellar luminosity function, IMF
    - Reading: SG 1.2-1.3, 2.1-2.2

- Stellar Populations, Stars in the Milky Way Disk
  - Reading: SG 1.1, 2.2-2.3
- Bulge and halo of Milky Way, Galactic rotation, dark matter in the Milky Way
  - Reading: SG 2.3-2.4
- Galactic dynamics, virial theorem, two-body relaxation,
  - Reading: SG 3.1-3.2
- Cluster dynamics, orbits, collision less Boltzmann equation
  - Reading: SG 3.3-3.4
- Local Group galaxies, Models of chemical enrichment, dwarf galaxies
  - Reading: SG 4.1-4.4
- Disk galaxies (radial density profiles, kinematics)
  - Reading: SG 5.1-5.4
- Spiral arms and galactic bars, galactic bulges
  - Reading: SG 5.5
- Elliptical galaxies: light distribution, orbits
  - Reading: SG 6.1-6.2
- Elliptical galaxies: stellar populations, dark matter, black holes
  - Reading: SG 6.3-6.4
- Galaxy groups, dynamical friction, galaxy mergers, starbursts.
  - Reading: SG 7.1
- Galaxy clusters, missing baryons, dark matter in clusters.
  - Reading: SG 7.2-7.3