ASTRON 329/429: Cosmology and Extragalactic Astrophysics (Fall 2015)

This course will provide a broad introduction to modern cosmology, the branch of physics that studies how the Universe began, what it is made of, how it has expanded with time, and how structures likes stars and galaxies formed out of the Big Bang. An understanding of the basics of cosmology is interesting in its own right and also essential for all students who plan to pursue research in astronomy or high-energy physics. The course will cover the now standard hot Big Bang cosmological model, including the evidence for dark matter and dark energy. Cosmology is an exciting and active area of research and the course will prepare students to understand some of the recent developments at the frontier of the field.

Instructor: Prof. Claude-André Faucher-Giguère
Email: cgiguere@northwestern.edu
Office: Tech F243
Office hour: Friday 2-3 PM
Course website: http://galaxies.northwestern.edu/teaching (follow links).

To save trees, problem sets will be posted on the course web site. If you miss a lecture, be sure to monitor the course web page and ask your classmates about possible assignments.

For questions about course material and homework assignments, please come to the office hour.

Cody Dirks (Tech F226, CodyDirks2017@u.northwestern.edu) will be the grader for the course.

Time and location: Tuesday and Thursday, 9:30-10:50, in Tech M349.

Textbook (required): An Introduction to Modern Cosmology (3rd Ed.) by Andrew Liddle. Wiley (ISBN: 1118502140).

Other useful references: Introduction to Cosmology by Barbara Ryden. Addison-Wesley (ISBN: 0805389121). Similar to Liddle. Very readable but more dated.

Extragalactic Astronomy and Cosmology: An Introduction (2nd Ed.) by Peter Schneider. Springer (ISBN: 3642540821). More advanced textbook – a useful reference for topics not covered by Ryden.

Modern Cosmology by Scott Dodelson. Academic Press (ISBN: 0122191412). Also more advanced – a useful reference for students planning to pursue research in cosmology.

We will cover most of Liddle's book. The textbook is written at the level of advanced undergraduates so it is easy read. The book is very concise and students who have less of an astronomy background should read chapters ahead of time and look up the relevant background as needed so they can follow the lectures.

More advanced topics that connect to current research will also be covered as time permits.

Course pre-requisites: The course is targeted at advanced undergraduates and graduate students. Undergraduates who register for the course should have a good understanding of electrodynamics, statistical mechanics, classical dynamics, and quantum mechanics at the level of physics majors. Students should have a good understanding of special relativity but general relativity is not required.

This course does not have a specific astronomy requirement, but students should be familiar with astronomical terminology and the astronomical context (e.g., what is a galaxy? what is a black hole? what is the interstellar medium? what is a redshift?) at the level of ASTRON 220.

Course evaluation: Grades for the course will be determined as follows:
40% homework assignments
20% mid-term exam
40% final exam

For the homework assignments, you are welcome to discuss problems with other students, but you must write up your own solutions independently. There will be approximately 5 homework assignments (one every other week). Assignments will be due in class. Grades for late assignments will be automatically reduced by 20% and a further 10% will be deducted for each day late. Assignments turned in more than five days late will not be graded except under extraordinary circumstances.

Following the registrar's schedule, the final examination will be on Monday Dec. 7, 3-5 PM in the regular classroom. The final examination will cover material from the entire quarter.

All graduate students should register for ASTRON 429. Undergraduates will generally want to register for ASTRON 329 instead. The lectures will be identical, but the homework problems and final exam will be graded differently (extra problems will occasionally be assigned to ASTRON 429 students).

Topics to be covered: fundamental observations and cosmological principles, the Friedman-Robertson-Walker metric and different cosmological models, dark matter and dark energy, measuring cosmological parameters, gravitational lensing, the cosmic microwave background, Big Bang nucleosynthesis and the early Universe, cosmic inflation, and the formation of cosmic structures. Time permitting, we will also cover some basics of galaxy formation and the intergalactic medium.