

PHYS-UA 15: Introduction to Cosmology

Fall 2021

Prof Jeremy Tinker

jlt12@nyu.edu

Office: 726 Broadway, room 905

Office Hours: 1:30-2:30 pm Wednesdays

TA: Arjun Suresh, as14006@nyu.edu

TA's Office Hours: 11:30-12:30 Wednesdays, (office TBA)

Course Description

This course is a technical but elementary introduction to the modern understanding of cosmology, intended for non-science students. We will cover advances in cosmology over the last 100 years, with special emphasis on more recent developments in the field. We will cover topics ranging from the early universe to galaxy formation in the present day universe, through the lens of the theory of relativity and the expanding universe. We will cover the Big Bang, the Cosmic Microwave Background, dark matter, dark energy and the associated evidence for these phenomena. Assumes a high-school level mathematics background. This course counts to the astronomy minor.

Course Text

Foundations of Modern Cosmology, Hawley and Holcomb, 2nd Edition.

- Please note that this text is available through the NYU Online library system.
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Course Grades

Midterm Exam - 25%

Final Exam - 25%

Homework - 25%

Class Project - 15%

Quizzes - 10%

Missed Midterm Exams: Exams are excused with a valid reason (illness with valid medical note, family emergency). Prof. Tinker must be notified before the exam. If this occurs, the final exam counts for 60% of your final grade.

Missed Final Exams: Finals exams cannot be missed except under extreme circumstances, which also must be discussed with Prof Tinker beforehand. If this occurs, an incomplete grade is given and the final exam is made up by sitting for the final exam the next time the course is offered.

Quizzes: Quizzes will occur randomly throughout the semester, approximately 4-5 times. Missed quizzes can be excused with appropriate doctor's note or family emergency. Excused quizzes will not count to your final grade.

Class Project: Throughout the course of the term, students will work on measuring the expansion rate of the universe using "fake" data generated on a computer. This will involve rudimentary measurements (using equipment no more sophisticated than a ruler) and small spreadsheet-like calculations. Every student is given a different universe with different properties, and the goal of the final project-- using the techniques covered during the semester-- is to determine which universe is yours. Data are distributed out after the midterm. This is due Dec 15.

Grading Scale: I use a 90%=A, 80%=B, etc, grading scale. There will be a curve applied to the *final* grades (not to individual grades or exams). Usually this is between 2-5%, depending on the exact grade distribution of the class.

There is **NO EXTRA CREDIT.**

Syllabus (Dates are the Monday of each week)

- Weeks 1-2: Math Review, and Introduction: The fundamental observations in modern cosmology
 - Chapters 1-2
- Week 3 (Sept 13): Background on Newton's mechanics
 - Chapter 3
- Week 4 (Sept 20): Background on light and the cosmological distance ladder
 - Chapters 4-5
- Week 5 (Sept 27): Spacetime and the Special Theory of Relativity
 - Chapter 6-7
- Week 6 (Oct 4): General Theory of Relativity

- Chapter 8
- Weeks 7-8 (Oct 11/18): The expanding universe and the Friedmann Equation
 - Chapters 10-11
 - Notes: **NO CLASSES TUESDAY OCT 12 (Legislative Monday)**
 - Notes: **MIDTERM EXAM OCTOBER 21 (in class)**
- Week 9 (Oct 25): The Age and Geometry of the Universe
 - Chapter 12 and review of Chpt 5
- Week 10 (Nov 1): Evidence for Cosmic Acceleration and Dark Energy
 - Chapter 13 and review of Chpt 5
- Week 11 (Nov 8): The Early Universe and the Cosmic Microwave Background
 - Chapter 14
- Week 12 (Nov 15): The Early Universe and the Theory of Inflation
 - Chapter 16
- Week 13 (Nov 22) : Evidence for Dark Matter and Large Scale Structure
 - Chapter 15
 - Notes: **NO CLASS NOVEMBER 25 (Thanksgiving)**
- Week 14 (Nov 29): The Cosmic Web and Galaxy Formation
 - Chapter 15
- Week 15 (Dec 6): Catch up, and Extrasolar planets and the prospects of life on other worlds
 - No reading
- Week 16 (Dec 13): Review session (Tuesday, Dec 14).
 - No reading
 - Notes: **Class projects DUE December 15**
- **FINAL EXAM: TBA in our usual classroom.**