

Sample Syllabus: Are we alone in the Universe?

Course Description: This is a freshman-level course with a broad emphasis on introducing the fundamentals of the origins of life and contemplating its existence across the Universe. We will cover topics such as the formation of stars and planets, and discuss our current understanding of the origins of life on Earth. We will also discuss ongoing global large-scale search efforts to find evidence of extraterrestrial life. We will carry out hands-on tutorial on actual data collected from the world's largest radio telescopes. There is no homework/assignment in this course but there will be weekly student-led discussion sessions. During these sessions, students will participate in the Q&A prepared by the instructor/teaching assistant.

Prerequisite(s): High-school level physics and astronomy, basic Python knowledge

Instructor: Vishal Gajjar **Course Website:** gajjarvishal.com

Teaching Assistant: one assistant to oversee student-led discussion every week on the topic being taught and lead Q&A.

Credit Hours: 3

Textbooks:

Origins of Life in the Universe by Robert Jastrow, Michael Rampino
Cambridge University Press, 2008

Suggested readings

Seager, Sara & Deming, Drake, *Exoplanet Atmospheres*, Annual Review of Astronomy and Astrophysics, 2010, Paper

Tarter, Jill, *The Search for Extraterrestrial Intelligence (SETI)*, Annual Review of Astronomy and Astrophysics, 2001, Paper

Tentative Schedule:

Week	Content
Week 1	<ul style="list-style-type: none">• Big Bang and the origin of the Universe• Reading: Chapter 2 from Book 1• Discussion: Astronomical measurements that determined the age of the Universe.
Week 2	<ul style="list-style-type: none">• Origin of the Solar system• Reading: Chapter 4 from Book 1• Discussion: Planetesimals, Origin of Earth and Moon system, Habitable zone
Week 3	<ul style="list-style-type: none">• Extrasolar planets and their searches• Reading: 5 ways to find planets by NASA• Discussion: Transit photometry and planet properties determination
Week 4	<ul style="list-style-type: none">• Current understanding of the origins of life on Earth• Reading: Chapter 11 from Book 1• Discussion: Building blocks of life and their abundance in space

Week 5	<ul style="list-style-type: none"> • Evolution of life and emergence of intelligence • Reading: Chapters 14 & 15 from Book 1 • Discussion: The Cambrian explosion, Natural Selection, Mass extinctions events
Week 6	<ul style="list-style-type: none"> • Mid-term exam
Week 7	<ul style="list-style-type: none"> • Detecting signs of life across interstellar distances • Reading; Seager and Deming 2010, Section 1 and 2 • Discussion: Space missions to detect biosignatures
Week 8	<ul style="list-style-type: none"> • Detecting signs of technologically-advanced extraterrestrial life • Reading: Tarter 2001 • Discussion: Radio Astronomy, Drake's Equation, Fermi Paradox
Week 9	<ul style="list-style-type: none"> • The Kardashev Scale • Reading: Tarter 2001 • Discussion: Megastructures, Light-sails, Galactic and Extragalactic SETI
Week 10	<ul style="list-style-type: none"> • Breakthrough Listen and on-going SETI surveys • Reading: Breakthrough Listen Tutorial • Discussion: Hands-on tutorials on signal searches carried out in SETI
Week 11	<ul style="list-style-type: none"> • Discussion: Look towards the future, Extending discussion from previous weeks, clear doubts with the instructor and TA, prepare for finals
Week 12	<ul style="list-style-type: none"> • Final Exam

Grade Distribution:

Class Q&A and Discussion participation	30%
Mid-term exam	30%
Final Exam	40%