Revision for Final Exam
PHY 700 Astrobiology

You will be responsible for everything we covered in class, including the readings, the lectures, and the discussions.

Below is a general list of topics we went over in class. You should be familiar with all of them. This list is not inclusive, but if you know these well, you will probably do well on the final.

The final will include some computation, some short-answer, and some longer essay questions. I will give you values for any physical constants you need (G, c, σ, etc.). Bring a calculator.

Concepts

- What do we mean by 'life'?
- What are the requirements for life on Earth?
- Why are water and carbon essential elements of life on Earth?
- What are our intrinsic biases when we search for life, and how can we deal with these?

Exoplanets

- Different search techniques
    - Astrometry (star shifting position)
    - Radial velocity (star getting doppler shifted to/from observer)
    - Transits
    - What quantities are measured by each search technique (mass, radius, density, etc?)
- Kepler mission
    - Overview of planets it has detected
    - Why is it optimized to detect Earth-like planets?
    - Limitations of Kepler mission? Advantages?
- Earth-like planets.
- Crazy non-earth-like planets: hot Jupiters, pulsar planets, etc.
- Habitable zone; continuously habitable zone.
    - Definition. Limitations.

Solar System

- What regions are habitable in solar system?
- Why are some regions of particular interest?
    - Mars
    - Titan
    - Europa
    - Enceladus
    - Others?

Origin of Life

- Chemical requirements
- Amino acids, nucleobases, proteins, RNA, DNA
- Single cell -> prokaryote -> eukaryote -> multi-celled -> complex -> intelligent
- Miller-Urey experiment
- Chirality

SETI

- Why radio?
- Active SETI (transmitting) vs. passive SETI (listening)
- Interstellar travel
- Why does it take so long?
- Traveling to, communication within solar system vs. others stars vs. other galaxies

Timeline

- Formation of Solar System
- Formation of Earth
- Oldest rocks on Earth
- Oldest biosignature on Earth
- Stromatolites
- Oxygenation of atmosphere and consequences
- Cambrian explosion
- Panspermia: arguments for and against.
- How does Mars' history compare to Earth's?

Equations and derivations

You should be able to use and understand any of these.

- Keplerian motion
  - Orbital speed
  - Escape speed
- Transits
  - Depth
  - Duration
  - Probability
- Radial velocity searches
  - Center-of-mass
  - Wobble motion of central star
  - Doppler velocity of central star
- Rockets
  - m_0/m_1
  - Δ_v
- Drake equation
  - Know what all the terms mean and justify values you like for them.
- Effective temperature
  - Effect of albedo
  - Habitable zone
  - Things that affect HZ
  - Black body radiation: σT^4, etc.
  - Contrast ratio between star, planets in reflected light
- Telescope Optics
  - Diameter and angular resolution
  - Radio vs. optical