Astro 14 – Astrophysics: Solar System and Cosmology
Spring 2018
Prof. David Cohen

Final Exam

Guidelines:

The exam will be held 9 am to noon on Wednesday, May 16 in SC L32.

Unlike the midterms, the final will be *open* book. In fact, you can bring notes, graded homework assignments – anything you've written in addition to the textbook and any handouts from class.

You will *not* be allowed to use your phone/computer. So, do *bring a calculator*.

The exam will be cumulative – it will cover material from the entire semester – but it will be somewhat weighted toward cosmology (since the two midterms have not covered very much cosmology).

Problems on the final will be somewhat more mathematical than the problems on the last midterm.

Topics:

Basic contents of the Solar System, patterns of motion (e.g. planets orbit in a plane) and structure (terrestrial vs. Jovian planets)

Distance measuring techniques

Angular size and angle-length-distance relationship

Basic properties of light: electromagnetic spectrum, photons from transitions of electrons in atoms, relationship among wavelength-frequency-photon energy

Kirchoff's laws (three different types of spectra)

Inverse square law

Blackbody radiation (conditions for a light source to be a blackbody, Planck spectrum, total energy scales with temperature to the fourth power, peak wavelength vs. temperature)

Doppler shift

Newtonian gravity

Newton's laws of motion

Centripetal acceleration, angular momentum, orbits and Kepler's laws

Solar System object properties and how we determine them

Hydrostatic equilibrium and basics of planetary atmospheres

Key properties of individual planets, Oort cloud, asteroid belt, Kuiper belt (e.g. why is Venus's atmosphere so much more carbon-dioxide rich compared to the Earths? Why are the comets in the Oort cloud in a spherical distribution?).

Formation of the Solar System and important patterns in the Solar System's properties (beginning of Ch. 12).

Exoplanets, especially techniques for measuring their properties (what can we learn from transit observations? From radial velocity observations?) (end of Ch. 12).

Beginning of cosmology: Hubble law, large scale structure, cosmological principle, lookback time, Olber's paradox, Newtonian Friedmann equation and the critical density.

Basics of the cosmic microwave background.

Geometry (particularly the three possible cosmological-principle-obeying ones), and how the angle-size-distance relationship is affected by non-euclidean geometry.

Proper distance (and the scale factor), horizon distance.

The general relativistic Friedmann equation, including in terms of energy densities and how each of the three components scale with the scale factor. Omega representations.

Relationship between scale factor and temperature; scale factor and wavelength and thus redshift; scale factor, it's derivative, and the Hubble parameter.

Solving the Friedmann equation under restricted cases; interpreting graphs of the scale factor vs. time and relating them to Hubble law graphs.

The concordance model and the evidence for its various components.

Basics of Big Bang Nucleosynthesis.