Topics: Material from the entire semester will be relevant for the exam. There will be a substantial weighting toward the second half of the course, but the material from the first half (e.g. radiation and matter from Ch. 5 or Kepler's laws and their underpinnings in Newtonian gravity) underlies much of the applied material from the second half. Major topics are: exoplanet detection and characterization, how we measure and characterize the properties of stars, spectral types and luminosity classes, the HR diagram, stellar structure and the (basic) physics behind HSEQ and nuclear energy generation, scaling relations that can be derived from subsets of the structure equations, the interstellar medium (evidence for dust, assessing reddening and extinction, evidence for gas in the ISM and the ways we can observe it), star formation and basics of post-main sequence evolution, galaxy properties and especially using Kepler's third law to show the existence of dark matter distributed throughout galaxies and of supermassive black holes at their centers, and the basics of the Hubble law (including both distance determination using standard candles and the relationship between the expansion rate of the universe and the age of the universe).

Being able to interpret graphical representations of data and of physical concepts (e.g. interpreting information in spectra; deriving the Hubble constant from measurements of galaxies' velocities and distances; describing stars' properties from their position in an HR diagram) will be important. As will the ability to apply concepts you've learned in new situations.

Parameters of the exam:

- The exam will be three hours (it will be only slightly longer than the midterms).
- It will be closed book. But I will provide you with several tables from the Appendix of the textbook, including all the physical constants you will need and also Table A.5 with information about stars, organized by spectral type. And maybe some other useful tables.
- You will be allowed to bring two sheets of hand-written (by you) notes. You can write on the back and the front. It can (and should) contain equations, sketches, conversion factors, and words. You *can* use the two sheets you prepared for the two midterms, but I *strongly* recommend you start from scratch and make new ones. Think about what you wished you had, but didn't, on the sheets you prepared for the midterms.
- Bring a calculator! You will not have access to your phone during the exam.

My primary pieces of advice for studying are: (a) Look over each week's reading assignments (the document I gave you about preparing for each class) and write down the few most important concepts from each week; (b) think about what type of problems you might be asked to solve for each of these concepts; (c) study with classmates and ask each other questions about the important concepts; (d) look over the homeworks (and midterms) and try doing the problems that gave you the most trouble (do them "blind" – don't look at your old answers or my solutions when you're doing them). Don't forget that homework number 9 exists.

Look over the list of problem topics I gave you for the second midterm. They're all relevant. Add the following: How does the post-main-sequence evolution of massive stars differ from that of low-mass stars and why, physically, can high-mass stars overcome the higher Coulomb barrier of nuclei with many protons in order to enable even those heavy elements to undergo fusion? How does the density- but not temperature-dependence of degeneracy pressure lead to more massive white dwarfs being smaller than less massive white dwarfs? What are the physical properties of white dwarfs and neutron stars and how can they be measured? Why are elliptical galaxies, with their relative lack of gas and dust, redder than spiral galaxies?