Astronomy 2291 – Exam 2 Study Guide

While we covered material in Chapters 3, 4, & 5 since Exam 1, not all topics were covered in lecture. The following are the topics that might appear on Exam 2. Note that not all topics on this sheet will be on Exam 2.

Newton's Form of Kepler's Laws:

First Law generalized to orbits on conic section with Sun at one focus
Second Law understood as conservation of angular momentum
Third Law: General form for any two massive bodies
Keplerian Approximation when $M_1 >> M_2$.

Orbital Mechanics:

Orbital Kinetic and Potential Energy
Dependence of eccentricity (e) on KE/PE (bound, unbound, & marginally bound orbits)
Circular and Escape Speeds, Orbital Speeds at periapse and apoapse
Vis-Viva Equation and Hohmann Transfer Orbits

Tides:

Differential Tidal Forces
Precession and Tidal Braking
Minimum Orbit: Roche Limit & Roche Radius
Maximum Orbit: Hill Radius

Lunar Phenomena:

Rotation is tidally locked to the Earth
Lunar Librations (Diurnal, Longitudinal, & Latitudinal)
Lunar and Solar Eclipses (types, eclipse year, occurrence)

Atomic Structure - the Bohr Atom:

Light: relationship between frequency, wavelength, and energy
Energy Levels (quantum number n)
Hydrogen-like atoms (Z-dependence of r_n, E_n, wavelength of transition, etc.)

Atomic Processes:

Excitation (collisional and radiative)
De-Excitation (collisional, radiative, and stimulated emission)
Ionization

Thermal Distribution of Atoms:

Maxwell-Boltzmann Distribution Function
kinetic temperature (T)
Derived properties from the Maxwell-Boltzmann distribution and how they depend upon the kinetic temperature:

- most probably speed (v_p)
- average speed ($\langle v \rangle$)
- mean kinetic energy ($\langle E \rangle$)
- root-mean square (rms) speed ($\langle v^2 \rangle$)

Local Thermodynamic Equilibrium (LTE)

Definition of LTE
Examples of astrophysical systems where LTE is a good approximation

Radiative Transfer:

Equation of radiative transfer
Attenuation of light by a slab in the pure-absorption case
Definition of Cross Section (σ)

Definition of Number Density (n)
Definition of Column Density (N)

Definition of Optical Depth (τ) - what is optically thick vs. optically thin?
Definition of Mean Free Path (l_{mfp})

Blackbody Radiation:

LTE, Boltzmann Equation (relative level populations in LTE limit)

Planck Function – Specific flux from a blackbody of temperature T (F_ν and F_λ), Rayleigh-Jeans and Wien limits

Total Flux of a blackbody source ($\sigma_B T^4$)

Total Luminosity of a blackbody source (area $\times \sigma_B T^4$)