Study Guide for Final Exam. Astronomy & Astrophysics I

Angular Resolution of the Eye and Telescopes
- Dependence on Diffraction theory
- Astronomical "Seeing"
- S/N in astronomical detectors

Blackbody Radiation from Stars
- Wien's Law
- Stefan-Boltzmann Law
- Color Temperature, Flux and Luminosity

Parallax and Distance
Magnitude and Absolute Magnitude

Spectral Type
- Stellar surface Temperature
- Absorption Lines (conditions of formation)

Line Profiles
- Natural, Pressure, Thermal, Rotational

Binary Stars
- Spectroscopic binaries
- Masses from RV curves
- Mass Function
- Sizes from Eclipse duration

Hertzprung-Russell Diagram
- Be able to plot it, with order of magnitude labels
- Know all the major features
- Explain the slope of the main sequence

Estimate the pressure at the center of the Sun

Apply the Virial Theorem to estimate the temperature deep in the Sun

Know the Proton-Proton Chain and CNO Cycle

Explain the quantum mechanical and thermodynamic principles that apply to the nuclear reaction rates in a star. (Gamow function, kinetic energy needed to overlap proton wavefunctions, Maxwell distribution)

Stellar Evolution.

- Main sequence to red-giant branch, to SN or WD
- Know the internal changes (core/shell burning),
- Timescales
- How the observable properties of stars respond.
- Evolutionary tracks on the HR diagram

Degenerate Matter -> Chandasekhar Limit, (physical outline of the derivation) WD, NS, BH

Properties of WD, NS, BH (Schwarzchild radius –semi-classical derivation)

X-ray Binaries

Observational differences between NS & BH

Pulsars -> Birth Spin, period derivative, spin-up during accretion, angular momentum conservation.

Radiation Pressure and the Eddington Limit

- Derivation using Thompson Cross section
- Application to BH luminosity, NS maximum spin-up, stellar mass upper limit

Tidal forces: Roche Limit

- Derivation of tidal disruption distance in terms of masses and radii of a pair massive orbiting bodies. E.g. Planet & moon, Star & Planet, BH & star.

Supernovae: Types, Physics, Lightcurve, Available energy, Nucleosynthesis, Neutrinos, Relic

Fragmentation of interstellar clouds (Jeans Instability)

Initial Mass function -> Relationship to spectral types and elemental abundances

Structure of Galaxies. Bulge, Disk, Dark matter, Stars, Gas, WIMPs, MACHOs

M.Sigma relation, Faber-Jackson and Tulley-Fisher relation

Cosmology: Hubble's Law, Critical density, supernova cosmology, CMB