

**Astronomy 45**  
**Introduction to Astrophysics**  
**Table of Contents**

## **1. Introduction to Astrophysics**

- 1.1 Introduction
- 1.2 Planets
  - 1.2.1 Geometry
  - 1.2.2 Parallax
  - 1.2.3 Transit of Venus
  - 1.2.4 Luminosity

## **2. The Astronomical Context**

- 2.1 Angles and Positions
  - 2.1.1 Coordinate systems in the sky
  - 2.1.2. Angular separations
  - 2.1.3 Solid angle
- 2.2 Brightness Measurements
  - 2.2.1 Flux and UBV system
  - 2.2.2 Apparent magnitudes
  - 2.2.3 Absolute magnitude
  - 2.2.4 Spectra
- 2.3 Velocity measurements
- 2.4 Distance Measurements

## **3. Radiation**

- 3.1 Photons
- 3.2 The specific intensity
  - 3.2.1 Flux
- 3.3 Energy Density
- 3.4 Radiation Pressure
- 3.5 Flux from a sphere of uniform brightness
  - 3.5.1 Thermal Radiation
  - 3.5.2 High and low T limits
- 3.6 Stefan-Boltzmann Law
  - 3.6.1 Einstein A and B coefficients
- 3.7 Radiation balance
  - 3.7.1 Temperatures of the planetary surfaces
- 3.8 Spectral Sequence of Stars
- 3.9 Other Radiation Mechanisms
  - 3.9.1 Synchrotron radiation
  - 3.9.2 Bremsstrahlung

## **4. Classical Dynamics**

- 4.1 Newtonian Gravity
  - 4.1.1 Newton's laws
  - 4.1.2 Gravitational potential
  - 4.1.3 Gravitational attraction of a spherical shell
  - 4.1.4 Solid sphere
  - 4.1.5 Two solid spherical bodies
- 4.2 The Two-body Problem
  - 4.2.1 Two-body orbits
  - 4.2.2 Runge-Lenz vector
  - 4.2.3 Orbits
  - 4.2.4 Mass of sun
  - 4.2.5 Interplanetary travel
  - 4.2.6 Moment of inertia of a spinning sphere
- 4.3 Binary Stars
  - 4.3.1 Supernovae in binary systems
  - 4.3.2 Tides
  - 4.3.3 Weak tides
  - 4.3.4 Tidal friction
  - 4.3.5 Roche stability limits for satellites
  - 4.3.6 Roche lobes
  - 4.3.7 Effect of mass transfer on binary orbits
- 4.4 The Virial Theorem
- 4.5 Gravitational Collapse

## **5. Stars and Stellar Structure**

- 5.1 Phenomenology
  - 5.1.1 Element Abundances
  - 5.1.2 Nuclear reactions
- 5.2 Stellar Structure
  - 5.2.1 Order of magnitude
  - 5.2.2 Stellar interiors
  - 5.2.3 Equations of stellar structure
  - 5.2.4 Boundary conditions
  - 5.2.5 Physical properties of polytropes
- 5.3 The Perfect (Ideal) Gas Law
  - 5.3.1 Adiabatic index
  - 5.3.2 Convection
  - 5.3.3 Equation of State for Degenerate Matter
  - 5.3.4 White Dwarf Stars
  - 5.3.5 Neutron Stars
  - 5.3.6 Black Holes
  - 5.3.7 Stellar structure virial theorem

## **6. Interstellar Medium**

6.1 Nebulae

6.2 Interstellar Gas and Dust

6.2.1 Phases

6.2.2 Hot gas