ASTRO 1010, Fall 2015, Class taught by Prof. Martens

Study Guide for Final Test, Thursday December 10th,

8:00 am – 10:30 am, South 608

Review notes, chapter slides (online), practice questions (online).

Chapter 1: Our Place in the Universe

- Astronomical Unit, parsec, light year
- Relative sizes of Earth and Sun
- Relative distances of the planets and nearest stars

Chapter 2: Discovering the Universe for Yourself

- Celestial sphere: NCP, SCP, celestial equator, ecliptic
- Local night sky: altitude, azimuth, zenith, horizon, meridian
- Angular size depends on physical size and distance
- Diurnal (daily) motions, circumpolar stars
- Apparent motion of the Sun over the year, causes of seasons
- Motion and phases of the Moon
- Eclipses of the Sun and Moon
- Motions of the planets, retrograde motion of superior planets
- Stellar parallax = expected semi-annual shift in nearby star positions

Chapter 3: The Science of Astronomy

- Geocentric model of Greek scientists, Eratosthenes measurement of the Earth's circumference
- Ptolemy: accurate planetary positions using multiple circles (epicycles)
- Copernicus: Sun centered Solar System
- Tycho: best measurements of planetary motion (especially for Mars)
- Kepler: three laws of planetary motion using ellipses
- Galileo: first telescopic observations of Moon, Sun, stars, Jupiter's moons, phases of Venus, and their consequences for the Copernican model

Supplement 1: Time and Coordinates

- Sidereal (star) and solar (Sun) time systems
- Synodic period of the Moon (with respect to the Sun), terms for special planetary positions
- Time zones, international date line, leap years
- Celestial coordinates right ascension (like longitude) and declination (like latitude)
- Diurnal motion and Sun's position in the sky seen from different latitudes on Earth, navigation

Chapter 4:

- Speed, velocity, acceleration, gravity
- Mass, weight, momentum
- Newton
- Three laws of motion
- Universal Gravitation
- Conservation of momentum, angular momentum, energy
- Gravitational potential energy, orbital velocity, escape velocity
- Newton's version of Kepler's third law and masses
- Gravity and tides

Chapter 5:

- Light as wave, particle, photons
- Wavelength x frequency = speed of light = 3×10^5 km/sec
- Electromagnetic spectrum
- Fahrenheit, Celsius, Kelvin temperature scales
- Planck curve for thermal radiation, color and temperature
- Kirchhoff laws for continuous, emission line, and absorption spectra
- Doppler shift and radial velocity
- Atoms, electron orbitals, energy transitions, molecules, states of matter

- Spectra and temperature, gas composition

Chapter 6:

- Refracting and reflecting telescopes
- Light gathering, angular resolution, magnification powers
- Imaging and spectroscopy
- Interferometry for high angular resolution, CHARA Array
- Atmospheric transmission, turbulence, light pollution
- Telescopes for radio, infrared, ultraviolet, X-ray, gamma-ray light
- Future telescopes

Chapter 7:

- Orbital and spin properties of planets
- Properties of terrestrial and Jovian planets
- Radii, masses, and composition of terrestrial planets
- Radii, masses, and composition of Jovian planets and Sun
- Asteroids, comets, Pluto and Kuiper Belt Objects

Chapter 8:

- Gravitational contraction of gas cloud or nebula
- Formation of disk (Solar Nebula) around newborn Sun

- Condensation of solids according to temperature in disk
- Accretion of solids into planetesimals
- Formation of terrestrial planets
- Formation of Jovian planets
- Formation of Earth's Moon
- Age of Solar System from radioactive dating

Chapter 9:

- Terrestrial planet interiors
- Seismic waves as probes of Earth's interior
- Metallic core by differentiation and origin of magnetic fields
- Core, mantle, crust, lithosphere
- Interior heating/cooling processes
- Shaping terrestrial surfaces by cratering, volcanism, tectonics, erosion
- Differences due to planetary size and distance from the Sun
- Cratering on surfaces of Moon, Mercury
- Mars: evidence of volcanism, tectonics, past surface water
- Venus: evidence of volcanism, tectonics, past resurfacing
- Earth: plate tectonics and associated structures

Chapter 10:

- Sources and losses of terrestrial planet atmospheres
- Example of Earth's atmosphere: composition, temperature, pressure
- Planetary albedo and temperature
- Greenhouse effect and temperature
- Weather, circulation patterns, clouds, precipitation, climate changes
- Atmosphere of Mars: composition, seasons, ice caps, dust storms, evidence of surface water
- Atmosphere of Venus: composition, cloud layers, runaway greenhouse effect
- Atmosphere of Earth: interaction of light and atmosphere in different layers,
- Carbon Dioxide Cycle and temperature stability mechanisms
- Carbon Dioxide and global warming

Chapter 11:

- Jovian planets: Jupiter, Saturn, Uranus, Neptune
- Spacecraft missions
- Composition, density, sizes
- Interior structure, magnetic fields
- Atmospheres: colors, bands, spots
- Jupiter's large moons: Io, Europa, Ganymede, Callisto

- Saturn's large moon: Titan (atmosphere) and Huygens probe
- Neptune's Triton (Pluto look-alike)
- Saturn's rings: composition, resonances, formation
- Rings of Jupiter, Uranus, Neptune

Chapter 12:

- Asteroid properties and orbits
- Meteors and meteorites (primitive, processed)
- Comets: "dirty snowballs"
- Comet nucleus, halo, plasma tail, dust tail; changes with heating
- Comet debris and meteor showers
- Comet origins in Oort Cloud
- Kuiper Belt Objects: Eris and Pluto
- Collision of Comet SL9 with Jupiter
- Collisions and impacts on Earth (extinction of the dinosaurs)

Chapter 13

Extra-solar planets:

- Direct observations of planets
- Observations of "wobbling"
- Doppler shift of central star

- Changes in brightness: Transits and eclipses
- First detection near Sun-like star, 51 Pegasi (1995)
- Effect of orbital inclination
- Kepler mission
- Measured properties: Distance, mass, size, eccentricity, atmospheric properties, density
- How does the solar planetary system compare to other systems?
- Hot Jupiters
- Distribution of masses, eccentricities and orbital distances
- Solitary planets
- Current status of planet discoveries