Spherical Astronomy

COURSE: Astronomy 201-01(2 credits), **Spherical Astronomy**

TIME: Spring 2008, 12:00 N -12:50 P.M. T,R

PLACE: Trafton C310

INSTRUCTOR: Dr. Steve Kipp **OFFICE:** Wissink Building 345 **PHONE:** 389-5912 (office), 389-2691 (Andreas Observatory) **E-MAIL:** steven.kipp@mnsu.edu **WEB ADDRESS:** http://mavdisk.mnsu.edu/stars/

TEXT: **Elementary Spherical Astronomy**, S. Kipp, 2009
This is the instructor's draft of a book that will be available from the Wissink copy shop. The lecture in class will follow this book. Some additional books for reference include:

Fundamental Astronomy, Karttunen, et al. (eds.)
Spherical Astronomy, Robin Green
Spherical and practical Astronomy as Applied to Geodesy, Ivan Muller
Practical Astronomy With Your Calculator, Peter Duffett-Smith
Positional Astronomy, Derek McNally
Spherical Astronomy, William Smart
The Astronomical Almanac, U.S. Naval Observatory, all years

EQUIPMENT: A programmable scientific calculator or computer software like Mathcad or a spreadsheet will be necessary to do calculations for the problems in this course. A calculator or software that can do matrix operations is desirable. However keep in mind that you will be required to show your work in problems and intermediate results are required. Consequently, programming the equations and only showing the final result is not acceptable.

COURSE CONTENT: In Spherical Astronomy we will discuss coordinate and time systems in astronomy. We will begin with a review of some important topics in trigonometry and a general discussion of spherical trigonometry. We will discuss coordinates on the Earth as a model for the use of spherical coordinates. Then we will describe the basic celestial coordinates: horizon, hour angle, equatorial, ecliptic and galactic. We will introduce sidereal time when discussing the hour angle and right ascension systems. We will discuss how to convert from one spherical celestial coordinate system to another. Then we will introduce the rectangular Cartesian coordinates associated with spherical celestial coordinates and we will discuss the conversion between different kinds of coordinates by coordinate rotations using rotation matrices. This discussion will include all the necessary background information on matrices. Next we will cover changes in position due to proper motion, precession, aberration, parallax and refraction. Then we will turn our attention to time. We will discuss sidereal time and various types of solar time. We will discuss precision atomic time along with dynamic time systems. Then we will discuss calendar systems. We will cover lunar calendars and the Julian and Gregorian solar calendars. We will spend considerable time discussing Julian day numbers. Finally, we will end our discussion of coordinates and time by introducing the International Terrestrial/Celestial Reference System/Frame -the latest in a high precision position systems.

COURSE SCHEDULE:

Week #	Date(s)	Topic/Activity
1	Jan. 13, 15	Introduction, spherical geometry, PS #1
2	Jan. 20, 22	Terrestrial, celestial coordinates, PS #1 due Jan. 22, PS#2
3	Jan. 27, 29	Celestial coordinates
4	Feb. 3, 5	Celestial coordinates, PS#2 due Feb. 5, PS#3
5	Feb. 10, 12	Celestial coordinates
6	Feb. 17, 19	Matrix intro., coordinate rotation, PS#3 due Feb. 19, PS#4
7	Feb. 24, 26	Coordinate rotation
8	Mar. 3, 5	Coordinate rotation,, PS#4 due Mar. 5, PS#5, Midterm, Mar. 5
9	Mar. 17, 19	Precession, proper motion,
10	Mar. 24, 26	Aberration, parallax, refraction, PS#5 due Mar. 26, PS#6
11	Mar. 31, Apr. 2	Time, solar, sidereal,
12	Apr. 7, 9	Time, universal, atomic, dynamic, PS#6 due Apr. 9, PS#7
13	Apr. 14, 16	Time, calendar
14	Apr. 21, 23	The calendar
15	Apr. 28, 30	Modern position, time systems PS#7 due Apr. 28
16	May 4 (Mon.)	Final exam 10:15 a.m. - 12:15 p.m.

The course schedule is approximate and is subject to change. Changes will be announced in class.

GRADING: There will be seven problem sets, a midterm and a final exam in this course. The problem sets will be worth 50 points each and the midterm and final exam will be worth 50 points each. Problem sets are due at the beginning of class on the dates indicated. A total of 450 points are possible in this course and your final score will be the percentage of this possible score you earn. (An extra credit project worth a maximum of 20 points will be discussed later.) The grading scale is as follows:

Percentage Score	Grade
[90 - 100]	A
[80 - 90)	B
[70 - 80)	C
[60 - 70)	D
<60	F

The problem sets will involve considerable calculation. They will be graded on the basis of the method as well as the answer. Neatness and promptness will be considered in the determination of the score. Points will be deducted from problem sets turned-in late according to the judgment of the instructor. Students are expected to be honest and responsible in the accomplishment of their academic work. While working with fellow students to understand course material is encouraged, a problem set should be solely the work of the student whose name is on it. Dishonest work will receive no credit. The midterm and final exams will consist of a mix of matching, short essay questions and short problems. All the material presented in class will be potential test material. Grades of incomplete will be given according to University policy.

OFFICE HOURS: Regular office hours are posted at my office. I will also be glad to meet with students by appointment. I am in my office much of the day. Feel free to drop by.

Spherical astronomy or positional astronomy is the branch of astronomy that is used to determine the location of objects on the celestial sphere, as seen at a particular date, time, and location on the Earth. This is one of the oldest branches of astronomy. It relies on the mathematical methods of spherical geometry and the measurements of astrometry. This is the oldest branch of astronomy and dates back to antiquity. Cambridge Core - Astrophysics - Textbook on Spherical Astronomy.Â The author considers the night sky as the celestial sphere and powerfully exploits the methods of spherical geometry. Most problems in which the precise determination of a heavenly body's position in the sky is important are considered in theoretical detail, and the necessary formulae are derived to a precision that is sufficient for all but the most specialist purposes. Positional Astronomy: Spherical trigonometry. A great-circle arc, on the sphere, is the analogue of a straight line, on the plane. Where two such arcs intersect, we can define the spherical angle either as angle between the tangents to the two arcs, at the point of intersection, or as the angle between the planes of the two great circles where they intersect at the centre of the sphere.Â There are many formulae relating the sides and angles of a spherical triangle.