Franklin & Marshall College - Physics and Astronomy Department
AST 312: Solar System Astrophysics
F. Crawford
Spring 2014 General Course Information and Policies

Welcome and Overview

Welcome to the Spring 2014 edition of *AST 312: Solar System Astrophysics*, taught by Froney Crawford. The web page for the course is
`http://venus.fandm.edu/~fcrawfor/teaching_spring_2014_a312.html`.
Assignments and announcements will be posted here, so please it regularly.

This course is a study of the characteristics of the Solar System from a physical perspective. This course follows naturally from *AST 121: Introduction to Astrophysics*, and AST 121 (or 100) is a pre-requisite. Since physics plays a major role in the discussion and understanding of the topics in this course, I will make free use of physical concepts that are typically seen at the freshman and sophomore levels (for instance, physical optics and diffraction, to give just one example). You should be familiar with physics at least at this level to keep up in the course. For this reason, *PHY 226: Classical Mechanics*, is a co-requisite.

The course is divided into modules. The discussion of each module includes a review of the physical principles and concepts needed to understand and connect phenomena observed in the solar system. The modules are outlined below:

- Module 1: Tidal Effects – Tides; Tidal Locking; Lagrange Points; Trojans; Non-inertial Reference Frames; Roche Limit; Io
- Module 2: Planetary Atmospheres – Opacity; Mean Free Path; Fluid Statics and Dynamics; Coriolis Force; Greenhouse Effect; Albedo; Scale Height; Atmospheric Escape
- Module 3: Planetary Composition – Hydrostatic Equilibrium; Temperature and Cooling of Interiors; Ideal Gas; Phases of Matter; Polytropic Spheres; Planet Size
- Module 4: Planetary Seismology – Harmonic Oscillator; Stress and Strain; Elastic Moduli; Elastic Waves in Solids; Refraction; Angular Momentum, Oblateness, and Moment of Inertia
- Module 5: Magnetic Fields – Magnetospheres; Magnetic Pressure; Auroras; Dynamos; Earth's Field; Van Allen Belts; Radiation Dosimetry; Jupiter and Io; Io Flux Tube and Plasma Torus
- Module 6: Solar Wind and Plasmas – Parker Model; Alfvén Waves; Magnetized Plasmas; Comet Tails; Radiation Pressure

We will discuss each of these modules in turn, with an assignment for each module.

Location and Times

The class meets Tue and Thu 10:00 - 11:20 a.m. in Kaufman 204.

It is essential that you come to all classes to master the concepts and material in this course. All absences, for any reason (including illness, athletic events, etc.) should be discussed *in advance* with the instructor. **Excessive absences can result in a significant lowering of your grade or failure/removal from the course** (see the Participation and Attendance section below – I'll use my judgment as to what "excessive" is here).

Instructor Contact Information

Instructor:	Froney Crawford
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Office Hours:	Mon 1:30-3:00 p.m., Wed 4:00-5:30 p.m.

Please, let's all use first names. Call me Froney.

Come see me anytime. Please do not hesitate to contact me; no question or topic is too small. If you are having a lot of trouble with the assignments or understanding the material, be sure to come to see me as *soon* as possible. A good way to get together is to arrange a mutually agreeable time with me, either by email or in person after class. I expect you to read your email and check the course web page regularly as I will make announcements and might answer some questions in this way. You should feel free to send me email when you have a question or comment. If you have concerns about the course or ideas about how to make it better, you should let me know immediately, either in person or by email. Don't wait!

Textbooks

The main textbook for the course is *An Introduction to Modern Astrophysics* (2nd edition) by Carroll and Ostlie.

You will also probably make use of several physics textbooks as supplemental resources, including introductory physics texts such as the one you used in Physics 111 and 112 and the excellent mechanics textbook *Classical Mechanics* by John R. Taylor. Please be sure to keep these textbooks handy.

Reading and Homework Assignments

Assignments will be handed out or posted online and will be due on the assigned dates (to be turned in by hand). Each assignment outlines the reading for that module as well as a series of problems to be done and turned in to be graded. Each assignment will typically be due a week after the last class discussion on that module. There are no late homeworks.

Exam

There will be a cumulative final exam which will be a take-home exam.

Independent Projects

During the last part of the course, we will have students presentations on independent topics. Each presentation will be roughly 30-40 mins.

The goal of the independent project is for you to go in depth into a facet of solar system astrophysics that we have not covered in the course. Each person will choose a single topic (or experiment) that directly relates to some aspect of solar system physics (this is purposefully broad). The goal is for you to go in depth and present this topic at a similar level of complexity as the course. Things that you should answer include:

- How does the project topic relate to material in the class?

- If appropriate, what are some experimental results that have been used to test the theoretical underpinnings of the topic? How did those experiments work?
- Is this topic an active field of research, and what are the unanswered questions in the subject that are currently being addressed?

The project presentations will be graded on 3 criteria:

1. whether or not you have achieved the depth with your material that we have been accomplishing the rest of the semester.
2. the organization of your presentation. It doesn't need to be flashy but it does need to make sense!
3. your back-of-the-envelope calculations. Each presentation should include two back-of-the-envelope calculations during the presentation. These should be incorporated into your presentation (rather than tacked on at the end) and designed to help us get a feel for some aspect of your discussion.

Some examples of possible topics are dynamical systems and planetary rings; orbital resonance and chaotic/non-linear systems; solar system and planetary formation and dating; asteroid dynamics and impact threats; extrasolar planets; and solar flares and fields. You could also choose another topic of interest.

I will ask each of you to determine your topic by the last class before spring break, but I encourage you to come up with something much earlier. Please discuss any ideas you have with me to ensure that it matches the general goals of the course and assignment. The proposal for your project should just be a paragraph describing what you are going to teach us including a couple sentences of how in depth you will go. Also include a sentence or two about how you'll begin your work to prepare.

Participation and Attendance

The participation grade is based on your questions and comments, either in class or after class, your attendance record, and your demonstrated effort to do the best you can in the class. Essentially, being present prevents you from losing credit, and sustained active participation and involvement in the course as a whole on top of being present will help you gain credit. Active participation in class will be noted and rewarded.

Grading

For the purposes of grading, a breakdown is as follows:

Homework Assignments	50%
Independent Project	15%
Final Exam	25%
Participation and Attendance	10%

I reserve the right to adjust your grade to some extent at the end of the semester to reflect effort, conscientiousness, participation, etc. (this is also reflected in the participation component of the grade).

Academic Misconduct

The important guiding principle of academic honesty is that you must never represent the work of others as your own. Cheating and plagiarism are very serious offenses that can have dire consequences. The following guidelines should govern your behavior in the course; please request clarification if you find yourself in any doubtful situations.

You may seek assistance from me, or your fellow students in doing the assignments and preparing for class discussions. You may also work together with other members of the class on the homework assignments (unless specified otherwise), and this is often quite beneficial. For your own good, avoid situations in which you are either contributing either too much or too little to such collaborations. *Just copying someone else's work is clearly a representation of another student's work as your own and is a violation.* This applies to copying down results worked out on a blackboard by other students as well as solutions written down on paper. Please be cautious about loaning your work to others, since this can also lead to problems for both parties.

The exams must be entirely your own work. Detailed instructions will be given on the exam itself and discussed in advance. You must use only those materials allowed in the instructions given on the exam. No collaboration of any sort is allowed once you start an exam.