Practical Astronomy: Instrumentation and Data Analysis
ASTC02
Fall 2022

Professor Hanno Rein

Lecture	Tuesdays 18:00 - 20:00
Observing	Tuesdays after sunset
E-mail	`hanno.rein@utoronto.ca`
Website	`https://rein.utsc.utoronto.ca`
Book	A very good book is *Astronomy Methods* by Hale Brandt. I will sometimes assign you a chapter from this book to review. A useful reference is *Observational Astronomy* by Edmund C. Sutton; Cambridge University Press. The book is available as an ebook from the UTSC library website. A more practical resource including project ideas is the book *Remote Observatories for Amateur Astronomers* by Gerald R. Hubbell, Richard J. Williams, and Linda M. Billard; Springer International Publishing.
Office	SW 504 C
Office hours	Online by appointment
About this course	This course will operate similar to a laboratory course. The lectures prepare you for the practical part, i.e. taking observations with the UTSC telescopes and performing data analysis. We will use the UTSC telescopes every Tuesday after the lecture if the weather is good. Please come prepared and bring any food or clothing you might need. Depending on the weather throughout the term, we might have to schedule observations on other nights if the weather on Tuesdays is not allow us to take enough observations. Note that attending these observing sessions is mandatory and you have to make arrangements to get home from UTSC safely late at night. The data analysis will be a major component of this course. You will learn how to process data with tools such as python, jupyter-notebooks, matplotlib, numpy and scipy. You are highly recommended to install this software on your own computer. This will make your life significantly easier than relying on university computers. The grade for the course constitutes of a midterm, a final-exam, lab reports and a participation mark.

Final Exam

The final exam will be an oral exam and will include some practical components. It will take place during the exam period. The exam may include, but is not restricted to, material from all lectures and all tutorials. You can use a non-programmable calculator and a celestial sphere.

Grading Scheme

The final grade will be calculated as follows:

Midterm	15 points
Final exam	35 points
Lab reports	25 points
Participation	25 points

Absences

In the case of a problem that supports an absence to a lecture, a test, an observing session, or the inability to submit a lab report on time, your grade will be calculated on the basis of all other work. In the case of a problem that supports the absence to one of the tests, your grade will be calculated by increasing the weight of the other test and the final exam. Valid and official supporting documentation must be submitted within five business days of the missed observing session, deadline, or test.

Accessibility

Students with diverse learning styles and needs are welcome in this course. In particular, if you have a disability/health consideration that may require accommodations, please feel free to approach me and/or the AccessAbility Services Office as soon as possible. I will work with you and AccessAbility Services to ensure you can achieve your learning goals in this course. Enquiries are confidential. The UTSC AccessAbility Services staff (located in SW302) are available by appointment to assess specific needs, provide referrals and arrange appropriate accommodations (416) 287-7560 or `ability@utsc.utoronto.ca`.

Academic Integrity

Academic integrity is one of the cornerstones of the University of Toronto. It is critically important both to maintain our community which honours the values of honesty, trust, respect, fairness and responsibility and to protect you, the students within this community, and the value of the degree towards which you are all working so diligently. Detailed information about how to act with academic integrity, the Code of Behaviour on Academic Matters, and the processes by which allegations of academic misconduct are resolved can be found online: `http://www.artsci.utoronto.ca/osai/students`.

According to Section B of the University of Toronto's Code of Behaviour on Academic Matters (`http://www.governingcouncil.utoronto.ca/policies/behaveac.htm`) which all students are expected to know and respect, it is an offence for students to:

- To use someone else's ideas or words in their own work without acknowledging that those ideas/words are not their own with a citation and quotation marks, i.e. to commit plagiarism.
- To include false, misleading or concocted citations in their work.
- To obtain unauthorized assistance on any assignment.
- To provide unauthorized assistance to another student. This includes showing another student completed work.
- To submit their own work for credit in more than one course without the permission of the instructor.

- To falsify or alter any documentation required by the University. This includes, but is not limited to, doctor's notes.
- To use or possess an unauthorized aid in any test or exam.

Specifically to this course, please be reminded that you need to understand every solution that you submit. If you work together on an assignment, you still have to understand your submission.

There are other offences covered under the Code, but these are by far the most common. Please respect these rules and the values which they protect. Offences against academic integrity will be dealt with according to the procedures outlined in the Code of Behaviour on Academic Matters.

Learning outcomes

The following is a list of learning outcomes that you should be familiar with by the end of the course. Note that this is not an exhaustive list but should merely be used an an indication of what the important aspects of this course are.

- You should be familiar with basic astronomical concepts such as coordinate systems, distances.
- You should be able to explain properties of stars, planets and galaxies.
- You understand basic concepts of taking astrophysical data using a telescope and a CCD camera. This includes stacking of images, dark frames, etc.
- You should be comfortable taking an observation with the UTSC telescopes by yourself and explaining the components of the telescope and their function.
- You can work with python based software to read in data, analyze and visualize it.
- You can draw informed conclusions from a given dataset, check for consistency and incorporate an error analysis.
- You should be able to write lab reports that are complete, concise, and easy to read by others.

Tentative Class Schedule

Week	Date	Topic
1	Sept 5	Introduction, getting familiar with the telescope
2	Sept 12	Coordinate systems
3	Sept 19	CCD Cameras
4	Sept 26	Electronics lab
5	Oct 3	Orbital motion of planets, asteroids and comets
	Oct 10	READING WEEK
6	Oct 17	Evolution of stars
7	Oct 24	Star clusters and galaxies
8	Oct 31	Distance measurements
9	Nov 7	Fitting and Markov Chain Monte Carlo
10	Nov 14	TBD
11	Nov 21	TBD
12	Nov 28	TBD