# PHYS 322: Observational Astronomy (Spring 2025)

### DATE/TIME

Thursdays 6:00 - 8:50 pm (or other clear nights. After Day Light Savings begins, 7:00 - 9:50 pm) However, due to the nature of night-time observation, be prepared to spend additional hours occasionally.

## LOCATION

407 Faculty Memorial Hall (lecture) and Faculty Memorial Hall Rooftop Observatory

## **OFFICE HOUR**

Thursdays, 2:00pm - 4:00 pm (other times by appointment)

## INSTRUCTOR

Professor Hyomin Kim Office: Microelectronics Center (MIC) 201 Phone: (973) 596-5704 E-mail: hmkim@njit.edu

#### DESCRIPTION

The emphasis of this course is observations of celestial objects using a telescope system. This is largely a lab-based, hands-on course in which students learn to use a telescope and camera system to obtain, present and analyze astronomical data using computational tools such as Python, IDL and Matlab. Prerequisite: PHYS320 (Astronomy and Astrophysics I, with grade of C or better).

#### LEARNING OUTCOMES

- Learn about optical/radio telescope and imaging systems for astronomical observations.
- Analysis of acquired data from the telescope system to measure physical properties of the celestial objects using programming languages (e.g., MATLAB, Python, etc.).

#### ORGANIZATION

- This is a largely hands-on course, in which students learn about astronomy by taking images using a telescope and camera and analyzing data from the observations.
- This class comprises observations at the observatory and occasional lectures/demonstrations in the classroom. Since it is difficult to estimate how long each lab will take (due to technical difficulty, weather, etc.), students are expected to use our class hours flexibly. That is, on a day when the observation takes longer than anticipated, students may be required to stay longer than originally scheduled or vice versa. Class may be rescheduled for another day or data taken in previous year(s) may be given in case of persistent inclement weather and/or there is no further lecture material for the lab. Students will be informed by the instructor prior to the class regarding rescheduling of the class (be sure to check your email frequently)
- If the class size is bigger than 5-6 students, students will be assigned into a smaller group to avoid crowdedness in the dome as it is not spacious enough to accommodate more than 5-6 people. The remaining group not participating in observations in the dome will stay in the classroom for data processing, reports and group discussions. Some labs can be done relatively quickly. In such a case, all the groups will conduct the labs by taking turns so everyone can experience the assigned observations. If observations cannot be done by multiple groups at a given day/time, one group conducts the assigned observations and share the acquired data for the rest of the students. The bottom line is that students should understand the uncertainties associated with the observation activities (class size, time it takes, weather, etc). Therefore, there will be some "play it by ear" approaches.
- Weather consideration: Most class times will be spent for observations. It can be cold outside. Prepare warm clothes when necessary. A flashlight (with a red light) is also helpful.
- Students will meet in Room 407 in Faculty Memorial Hall before staring observing session. All
  observing sessions are at the observatory on the roof of Faculty Memory Hall.

- There are no exams. Only lab reports, homework, and attendance will be graded. Lab reports are the final product of each lab assignment, and must be prepared as a separate document, well-illustrated and explained. Neatness and thoroughness counts! The lab reports will be graded by the instructor.
- Although your attendance may not be checked in every class, make sure to attend, as you will need to understand how images and data are obtained. If you must miss a class, please send me an official notification in advance via email.
- Lab report due dates: The due dates for the assignments are by 11:59pm on Fridays in the following week after each lab assignment is complete (except for the first report). If you have a legitimate excuse for not getting the lab done on time (i.e. equipment or weather not cooperating or due to sickness), seek permission to turn it in late from the instructor. Otherwise, you will receive 5% reduction in credit per week for a late lab report.
- Final project: The final project consists of an imaging project to be done at the United Astronomy Clubs of New Jersey (UACNJ) Observatory (<u>uacnj.org</u>), Jenny Jump State Forest, Hope, NJ. Since it may be difficult to find a good weather AND a good schedule for the observatory, we will try to visit the observatory well before the final exam period (possibly, in April). This event may be subject to cancellation due to the difficulty associated with logistics. In such a case, the observation will occur at NJIT or historic data will be given.
- Use of Canvas: Lab assignments and reading materials will be shared on Canvas. Some contents (e.g., schedule, in particular) are subject to change due to uncertainties related to the weather, class size, etc.
- Mode of delivery: It is expected that the students attend the class IN PERSON. There will be NO virtual mode of delivery (unless otherwise announced).
- Food and drink are allowed in the classroom (407 FHM). In the observatory, any spillable food/drink are not allowed.

# TEXT AND REQUIRED SUPPLIES

А

С

- Readings: Read over the lab assignment before the corresponding class period.
- Textbook (desired but not required in class): Observational Astronomy 2nd Edition, D. Scott Birney, Guillermo Gonzalez, and David Oesper, Cambridge University Press 2006.
- Lab Notebooks: It is highly recommended to have a lab notebook containing your notes while you take and analyze your data.
- Computer and Software: A personal computer is necessary for data analysis. It is required to install necessary software (free). A smartphone sky map app is highly recommended. A programming language to read astronomical data (e.g., \*.fits) should be installed on your computer. Python is highly recommended.

# GRADING

The course grade will be based on lab reports (70%), homework (10%), attendance and class participation (20%). The grading breakdown is as follows:

- 85-100%
- 80-84% B+
- 70-79% B
- 65-69% C+
- 55-64%
- 50-54% D
- 0-49% F

# ACADEMIC INTEGRITY

Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the academic code of integrity policy that is found at: <u>NJIT Academic Integrity Code</u>. Please note that it is my professional obligation and responsibility to report any academic misconduct to the Dean of Students Office. Any student found in violation of the code by cheating, plagiarizing or using any online software inappropriately will result in disciplinary action. This may include a failing grade of F, and/or

suspension or dismissal from the university. If you have any questions about the code of Academic Integrity, please contact the Dean of Students Office at <u>dos@njit.edu</u>.

# OFFICE OF ACCESSIBILITY AND RESOURCES

Students who need academic accommodations in connection with a disability must initiate the request with NJIT Office of Accessibility and Resources (OARS). Students need to register with the Office of Accessibility in order to officially disclose their disability status to the College and to determine eligibility for appropriate reasonable accommodations (including any prior IEPs or 504s). Please contact OARS at the start of the semester (or as soon as possible) to coordinate any accommodation request/s: <a href="https://www.njit.edu/accessibility/">https://www.njit.edu/accessibility/</a>, Room 201 (Kupfrian Hall) or email us at OARS@NJIT.EDU

## **GENERATIVE AI**

In general, students are allowed to use generative AI tools (e.g., ChatGPT) to assist report writing and coding. However, it is not acceptable to copy and paste the entire contents generated by AI tools as it may be considered as plagiarism. The final product (lab reports) must be your own work.

## **VIDEO RECORDING**

Video recording is allowed only to help students understand lab settings/procedures. Recording the entire lecture/class is prohibited.

Date	Activity
Week 1 (01/23)	Review syllabus, Instructions regarding observations
	Basics of telescope/camera system for astronomy
	Introduction of software: Aladin, Cartes du Ciel, N.I.N.A., Astronomy.net,
	smartphone apps, etc.
Week 2 (01/30)	LAB 1: Learning the System
	Operate the telescope and camera to take images
Week 3 (02/06)	LAB 2: Proper Motion
	- Basics of astrometry (astrometry.net)
Week 4 (02/13)	LAB 2 (continued)
Week 5 (02/20)	LAB 3: Digital Imaging
	- CCD/CMOS sensors
	<ul> <li>Calibration procedures (bias and dark frames)</li> </ul>
	- Python image analysis
	Signal to noise radio and photo statistics
Week 6 (02/27)	LAB 3 (continued)
Week 7 (03/06)	LAB 4: Asteroids
	<ul> <li>Precision astrometry and photometry of moving objects</li> </ul>
	<ul> <li>Calibration (including flats), combining, and aligning of images</li> </ul>
	Finding moving objects with Astrometrica.
Week 8 (03/13)	LAB 4 (continued)
	Lunar eclipse (03/13-03/14)
Week X (03/20)	NO CLASS (SPRING RECESS)
Week 9 (03/27)	LAB 5: Eclipsing Binary Stars_
	- Planning observations
	- Precision photometry
	- Obtaining light curves
	- Epoch fitting
	- Binary star analysis
Week X (04/03)	NO CLASS (WELLNESS DAY)
Week 10 (04/10)	LAB 5 (continued)
Week 11 (04/17)	LAB 6: Radio Astronomy, Spectroscopy or Solar Imaging
	<ul> <li>Use SDR to measure radio signals from space.</li> </ul>

#### **CLASS SCHEDULE FOR SPRING 2025\***

	<ul> <li>Use a spectrograph to measure spectral lines</li> </ul>
	- Take images of solar disk (H-alpha)
Week 12 (04/24)	LAB 6 (continued)
Week 13 (05/01)	LAB 7 (FINAL PROJECT)
	- Make a true-color deep sky image
	<ul> <li>Observe from a dark sky site (<u>http://uacnj.org</u>)</li> </ul>
	- Choose your own object to image
	<ul> <li>Take images in multiple color filters</li> </ul>
	Learn to combine LRGB filters to a single color image.
Week 14 (05/06)	LAB 7 (continued)
TUESDAY	Thursday classes at NJIT run on Tuesday (May 6) - Last day of class
05/13	LAB 7 (Final Project) due

\*The schedule and lab topics may be subject to change (e.g., due to weather, technical difficulty, etc.).