Texas Tech University Department of Physics

CRN 30937 Astronomy 2401 Observational Astronomy

Course Information Autumn, 2013

Lectures: 3.30-4.50 pm Tu, Maths 012: 5.00-6.20 pm Th, Sc 121. It is imperative that you attend all classes since there is no textbook. Also the Thursday class will be mostly devoted to computer work that you will put into practice the following week.

Laboratory Sessions: Tuesday nights at the observatory: Meet at sunset. Actual time will vary throughout the semester. In the event of cloud, we will meet in Sc 121 at 8.00 pm.

Instructor: Assistant Professor Maurice Clark. Office: Sc 014 Phone: 806-742-3781
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Office Hours: Thursday 1:00-3:00 pm. Friday 1.00-2.00 pm. These are the times when I will be available in my office for discussions on any problems you might be having with the course. You are also welcome to come up to my office at any other time, although I cannot guarantee to be available.

Grading:

Essays	2 x 6%	12%.	
Project		20%.	
Observing Portfolio:		20%	
Computer Labs	8 x 3%	22%	
Comprehensive final		24%	(Just what the name implies)

Grades: The following are the grades to be awarded for this course and the ***approximate*** scores for which they will be awarded.

A	Has met the course objectives with distinction.	85% +
B	Has met the course objective with credit	73% - 84%
C	Has met the course objectives.	60% - 72%
D	Has met some of the course objectives.	50% - 59%
F	Has failed to meet the course objectives.	49% or less.

Course Format:

As the name implies, this course is about observational astronomy. While the labs and observing sessions will give you practical experience in observing the universe and in analysing those observations, the lectures will give you the "theoretical" background into why we use certain types of equipment and why we perform the analysis the way we do. There are no weekly assignments or mid-terms, however twice during the semester, you will be required to submit a paper dealing with some aspect of the course material just covered, that you have researched yourself, and there will be a comprehensive final exam at the end of the course. We will be covering the course material in lecture format on Tuesdays, while the Thursday class will be either a lecture or and lab session on the computers, devoted to going over what you will need to know in order to be able to operate the telescopes and process and analyse CCD images, and also to discussions about the requirements for the essays. However I want to encourage you to ask questions during the lecture. Whether about the lecture or about any problems you encounter. Remember…. **NO** question is too stupid to ask!!! If you are unsure about something, it is almost certain the several others will be as well. Be sure to let me know if I mention something you are unfamiliar with and help me adjust the pace of the course to better suit your needs.

Course Purpose:

Astronomy 2401 is aimed at those who have an interest in astronomy and who would like to learn more about how to observe the universe and image some of the wonders it contains. It is intended to satisfy anyone who is interested in astronomy as a hobby and provide a foundation in how to collect and analyse data for someone who intends to continue in astronomy professionally. For those interested (or who inadvertently become interested), it will give you the tools to continue astronomy as a lifelong interest. Since it assumes a certain level of knowledge of astronomy, it has the prerequisite of either AS 1400 or AS 1401. Students who do not have either of these, may be permitted to enrol in the course provided they can demonstrate to the course instructor that they have sufficient background knowledge of astronomy.

Expected Learning Outcomes:

Upon completion of this course, students will be able to:

1. Gain proficiency at operating a computer-controlled telescope and imaging equipment, and to find objects in the sky.
2. Understand the different types of modern detectors used by astronomers, their operation, and their limitations.
3. Use a CCD and a DSLR to take images of celestial objects and then process those images either as "pretty pictures" of analyse them scientifically.
3. Have the tools needed to continuing enjoying astronomy on their own as a hobby if desired, including using a simple telescope to make observations of and identify celestial objects.
4. Understand the various types of variable stars, their study, and their importance in astronomical research.
5. Understand the various methods used to discover extra-solar planets and the results of those searches.
6. Research a celestial object. Image that object, and then present the results of that work verbally to their peers.

The objective of the study of the natural sciences component of a core curriculum is to enable the student to understand, construct, and evaluate relationships in the natural sciences, and to enable the student to understand the bases for building and testing theories. The natural sciences investigate the phenomena of the physical world.

Students graduating from Texas Tech University should be able to: explain some of the major concepts in the Natural Sciences and to demonstrate an understanding of scientific approaches to problem solving, including ethics.

(1) **Labs/Night-time Observing sessions**: A major part of the course is learning how to use telescopes both for visual observation and for taking images. Another important component of the course is learning how to process and analyse images taken with a CCD. Therefore, every week during the semester you will have an observing session scheduled at the observatory. If the weather is unfavourable for observing that week, there will be an indoor lab session conducted in the computer room. Due to the sometimes questionable Texas weather, we will need to be very flexible as to whether we will be indoors doing a computer lab or outdoors observing. Also, as the semester progresses, the time of sundown will vary, especially with daylight saving time. So we will need to be flexible as to the starting time of the observing sessions. Finally, ***be warned***, at times during the semester it will get ***very cold at the observatory***! So ***dress appropriately***.

(2) **Observing Portfolio:** Making observations is of little use unless they are recorded. Therefore an important component of your grade for this course comes from your observing portfolio. This portfolio will contain your records and logs of all of observing sessions, sketches of objects that you have observed visually, prints of objects you have imaged, and any other relevant material.

(3) **Essays:** During the semester you will be required to write 2 essays dealing with material covered during classes. These should be about 4 pages in length and you will be expected to research the material yourself. The material covered in class will only be an introduction.

The papers that you hand in should be the result of **your own** work, with ideas expressed in your own words. **Violations of this policy are taken very seriously.** Plagiarism and collusion are considered **very serious offences**. Please remember the following, which is part of the Standard Texas Tech Policies that apply to all of your classes:

Students will foster a spirit of academic integrity, and they will not present work as their own that was not honestly preformed by them. For a complete description of this policy see Texas Tech Operating Policy 34.12.

Throughout the semester, I hope you take the opportunity to talk to your fellow ASTRO 2401 students about the material you are learning, and how to apply it during exams and essays — sometimes the best way to learn something is to hear it more than one way, or to try and explain it to someone else! However, please remember that in the end, all of your work must be your own. Indeed, you'll want to make sure that you understand the material yourself, for when you walk into the lecture hall to take your exam, you will have no one to help you but yourself!

(4) **Project:** Towards the end of the semester, you will be asked to make a classroom presentation dealing with some object in the sky that you have researched and imaged for yourself. The presentation should be about 10 minutes duration and should cover why you chose this particular object, interesting information about the object that you have found, the displaying of images you have taken of the object and a discussion of the taking and processing of these images.

(5) **Final Exam:** This will be a comprehensive exam held during the scheduled exam time and will cover material from class and from the labs, as well as any material that you have been assigned to read.

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Course Syllabus

Here is a **tentative** outline of the lecture topics for the term and the associated lab work. Some modifications may be made depending on how the weather co-operates! ☹

	Date	Topic	Work Due	Labs
Week 1	T Aug 27 Th Aug 29	Using a computerized telescope:- Control software. Set-up and Alignment. Planning and Recording Observations:- Observing log suggestions. Lab exercise 1: Using "The Sky"		Observing: Using a telescope:- Telescope Set-up Visual observing
Week 2	T Sept 3 Th Sept 5	Using a CCD: What is a CCD. Image Processing:- Calibration Reasons for calibration. Theory of image processing. Dark frames. Flat Fields. Lab Exercise 2: Planning Observations		Observing: CCD imaging:- Black & White.
Week 3	T Sept 10 Th Sept 12	Image Processing:- Monochrome. Using Photoshop. Lab Exercise 3: Image Processing:- monochrome		Observing: CCD imaging:- Black & White.
Week 4	T Sept 17 Th Sept 19	Theory of colour imaging. RGB Images Powerpoint presentations:- Choosing your object. Lab:- Processing your own images	Observation portfolio due. Interim grade	Observing: CCD imaging:- Colour.
Week 5	T Sept 24 Th Sept 26	Image Processing:- Colour False-colour narrow-band images. Lab 4: Image Processing:- Colour.	Essay 1 due	Observing: CCD imaging:- Colour.
Week 6	T Oct 1 Th Oct 3	DSLR imaging. Lab:- Processing your own colour images		Observing: CCD imaging:- Narrow-band imaging.
Week 7	T Oct 8 Th Oct 10	Variable star photometry:- Photometry theory. Filtered/unfiltered. Photometry software. Lab Exercise 5: Photometry		Observing: CCD imaging:- Variable star photometry.
Week 8	T Oct 15 Th Oct 17	Variable Stars I:- Cepheids. Lab:- Processing your own variable star images		Observing: CCD imaging:- Project imaging.
Week 9	T Oct 22 Th Oct 24	Variable Stars II:- Long-period variables. Eruptive variables. Lab:- Processing your own images		Observing: CCD imaging:- Project imaging.

Week 10	T Oct 29 Th Oct 31	Spectroscopy Lab Exercise 6: Spectroscopy:- Spectral Types	Observation portfolio due. Interim grade	Observing: CCD imaging:- Project imaging.
Week 11	T Nov 5 Th Nov 7	Spectroscopy Lab Exercise 7: Spectroscopy:- Radial Velocities	Essay 2 due	Observing: CCD imaging:- Project imaging.
Week 12	T Nov 12 Th Nov 14	Planetary imaging:- Problems in imaging the planets. Planetary image processing software. Lab Exercise 8: Image Processing:- Planets		Observing: CCD imaging: Planets
Week 13	T Nov 19 Th Nov 21	Asteroid Astrometry:- What is astrometry? Why undertake it? Astrometry software. Lab:- Processing your own images		Observing: CCD imaging: extra-solar planetary transits? Spectroscopic imaging?
Week 14	T Nov 26 Th Nov 28	Trial Project presentations. **No classes** **Thanksgiving Break**	Observation portfolio due Final Grade	Observing: CCD imaging: Free imaging.
Week 15	T Dec 3 Th Dec 5	Final Project presentations. **No Classes**		
Week 16	Sat Dec 7	**Final Exam** 1.30 - 4.00pm **Will have to be re-scheduled!**		