ASTR 2401 Observational Astronomy

Syllabus Section 301 CRN 30937, Texas Tech University, Fall 2016

This course will cover the basics of astronomical observation using optical telescopes. It will provide the foundations for conducting astronomical research as a professional or advanced amateur astronomer.

Instructor

Dr. Robert C. Morehead

Contact

- **Email:** robert.morehead@ttu.edu (Preferred Contact Method)
- **Phone:** (806) 834-7940
- **Office:** Science Building room 14, TTU campus
- **Open Office Hours:**
  Monday 3 - 4:30pm
  Tuesday 9:30 - 11am
  Thursday 9:30 - 11am
  Friday 10:30am - 12:30pm
- **By Appointment:** http://rmorehead.youcanbook.me. This site links directly to my calendar and displays all the times I am free, eliminating the need for several emails back and forth to schedule an appointment.

Class Meetings

Tuesday 3:30 - 4:50pm
Science Building RM 112

Thursday 3:30 - 4:50pm
Science Building RM 121

Tuesday **OR** Thursday Dusk
Preston Gott Skyview Observatory

In the case that the observatory session is canceled on a given night, we will instead meet in Science 121 at 8:00pm.

Learning Objectives

After completing these course students will be able to:

- Set up and operate a computer controlled telescope and related instrumentation.
- Plan and execute a detailed astronomical observing plan.
- Record and analysis telescopic data, including imaging, photometry, and spectroscopy.
- Clearly communicate scientific results verbally and in writing.

Required Materials

Textbook

None is required. However, I will be basing many of my lectures on *Telescopes and Techniques* (ISBN: 978-1-4614-4890-7), by Kitchin. You can download a copy of book for free from the TTU Library, just search for the title on the Library website http://library.ttu.edu/.

Lab Notebook/Observing Portfolio

You will be required to keep a lab notebook/observing portfolio through out the course. It must be permanently bound with number pages. An expensive, special purpose notebook is not required. I recommend a cheap composition book with the pages numbered by hand.

Flash USB Thumb/Stick Drive

The observatory lacks internet, so you need some way to keep and transport your data. A thumb drive of 4 GB or greater will be sufficient.

Recommended Materials

A flashlight with a red filter. Some may be available at the observatory, but you may find it convenient to have one of your own.

Bug spray, warm clothes, etc. for observatory sessions.

Course Websites

Blackboard: http://ttu.blackboard.com. Blackboard will only be used for posting grades for this course. All other materials will be posted on an external course webpage (url TBA).

Course Requirements

I expect you to be considerate to me and to your classmates during class. **You are expected to turn off phones, iPods, and other electronic devices not necessary for class before class begins.** Laptops are allowed for note-taking or following along with course materials only. Please arrive on time, do not pack up your things before class is over, remain until the end of the class period, and notify me before class if you need to leave class early. If you are distracting your classmates or disrupting the class you will be asked to leave.

In return, I will start and end class on time, give you time in class to discuss concepts with your classmates, ask for your feedback about the class, and will be welcoming of all of your questions during class and during my office hours.

Assessment

Students' understanding of the learning goals will be evaluated from the records in their lab notebooks, project write-up, project presentation, and exams.

Grades

Your final numerical course grade will be calculated as a weighted average of:

- Midterm Exam: 10%
- Cumulative Final Exam: 20%
- Lab Notebook/Observing Log 28% (2% per lab)
- Project Proposal 5%
- Project Presentation 15%
- Project Write-Up 20%
- Attendance: 2%

No extra credit will be given and grades will not be rounded up. Although I may adjust the lower end of the grade cutoffs listed below, I guarantee that if your final grade is in the following percentage range you will receive the listed letter grade:

Numerical course grade	Letter grade
>=90.0%	A
80.00%-89.99%	B
70.00%-79.99%	C
60.00-69.99%	D
<60.00%	F

Attendance Policy

Faithful attendance is necessary to do well in this course and is required. During each class/lab/observing session, I will pass around a sign-in sheet that will be the official record of attendance. You must notify the instructor ahead of time to be excused for absences due to official university events.

If severe illness occurs, seek treatment immediately, contact the instructor as soon as possible, and **stay home**. A plan for any make-up work will be made an individual basis, and documentation from a medical professional may be required. In case of an illness that will require absence from class for more than one week, the student should notify his or her academic dean.

Laboratory and Night-time Observing Sessions

There are 8 computer-based labs and 6 observing labs as part of the course. All of these activities will be recorded in your lab notebook/observing log, which you will hand in a various points throughout the semester.

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 analyze 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 unfavorable for observing that week, there will be an indoor lab session conducted in the computer lab (SC 121) at 8pm. 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.**

Semester Project

Every student will complete a semester long observing project on the topic/object their choice. This project may be done independently or with a partner. This project should be one that ambitious, but that can be completed in the limited time available over the semester. So potential projects to consider:

- A portfolio of telescopic or DSLR astrophotography for multiple objects
- Producing a color-magnitude diagram of a star cluster
- Producing and fitting a variable star light curve
- Modeling the light curve of an eclipsing binary star
- Producing and fitting a transiting exoplanet light curve
- Producing technical benchmarks for observatory telescopes
- Confirm the spectral type of known star

The project will consist of 3 parts

1. A 2 page proposal outlining the project, its goals, and a reasonable plan to accomplish it.
2. A 10 minute final presentation to the class giving sufficient background about the project, the details of the observations, and the results.
3. A written report of the project (10 page maximum) with sufficient background, details of the observations data including data reduction, project results, and the implications of the results. This report should have enough detail that another astronomer would be able to reproduce the project.

Midterm Exam Policy

There will be one midterm exam. There is no make-up day for the midterm exam unless severe illness occurs (see class policies regarding illness). In the event of a documented direct conflict (two exams scheduled at the same time on the same day), students should contact the instructor at least 10 days before the exam. Alternative arrangements for the exam TIME (the exam day will NOT be changed) will be offered. The midterm exam will cover material up to the date of that exam, it will be administered in the lecture room, and you will need to bring a non-programmable scientific calculator, and your Texas Tech ID.

Final Exam Policy

There will be one final exam worth 20% of the final numerical course grade. There is no make-up day for the final exam: the Final Exam is mandatory. The final exam is comprehensive, it will be administered in a room to be announced later in the semester, and you will need to bring a non-programmable scientific calculator and your Texas Tech ID. Final examination period for **Fall 2016 WILL BE CONFIRMED LATER IN THE SEMESTER BY THE UNIVERSITY REGISTRAR**. For this reason, **DO NOT PLAN TO LEAVE TTU BEFORE OR ON Dec 14th**. TTU's policy regarding final exams states:

1. ALL Final Exams must be given at the assigned time. They may not be given prior to the officially assigned time.
2. If a student misses their Final Exam, they must contact their Instructor. This is a matter between the student and the Instructor. The policy for this class is that no make-up Final Exams will be given except in the event of severe documented illness.
3. There is no policy on how many Final Exams a student can have in one day. The Final Exam Schedule was posted in the Schedule of Classes and must be followed. For more info about the final exam policy, please visit: http://www.depts.ttu.edu/opmanual/OP34.10.pdf

Course Schedule

This projected schedule is subject to change. Observational astronomy is at the mercy of the West Texas weather.

Date	Lecture/Lab Topics	Observing	Due Dates
Tue, Aug 30	Intro and Coordinate Systems	No Observing	
Thu, Sep 1	Lab Exercise 1: Using the Sky	No Observing	
Tue, Sep 6	Setting up Telescops/Observation Planing	Visual Observing	
Thu, Sep 8	Lab Exercise 2: Observation Planning	Visual Observing	
Tue, Sep 13	CCD Therory and Calibration	Monocrhome Imaging	
Thu, Sep 15	Lab Exercise: 3 CCD Image Processing Monochrome	Monocrhome Imaging	
Tue, Sep 20	CCDs Cont, Telescope Basics	Color Imaging	
Thu, Sep 22	Lab Exercise 4: CCD Image Processing Color Images	Color Imaging	Lab notebook/Log I Due Friday 09/23 by 5:00pm
Tue, Sep 27	Telescopes and Optics	CCD imaging:- Narrow-band imaging.	
Thu, Sep 29	Lab -: Processing your own images	CCD imaging:- Narrow-band imaging.	Project Proposal Due
Tue, Oct 4	Photometry	CCD imaging: - Variable star photometry.	
Thu, Oct 6	Lab Exercise 5: Photometry	CCD imaging:- Variable star photometry.	
Tue,			

Oct 11	Mid Term	Project Observing	Mid Term
Thu, Oct 13	Lab -: Processing your own variable star photometry	Project Observing	
Tue, Oct 18	Time Domian Astronomy	Project Observing	
Thu, Oct 20	Lab Project Data Reduction in Lab	Project Observing	Lab notebook/Log II Due Friday 10/21 by 5:00pm
Tue, Oct 25	Spectroscopy	CCD imaging:- Spectroscopy imaging	
Thu, Oct 27	Lab Exercise 6: Spectroscopy:- Spectral Types	CCD imaging:- Spectroscopy imaging	
Tue, Nov 1	Spectroscopy	Project Observing	
Thu, Nov 3	Lab Exercise 7: Spectroscopy:- Radial Velocities	Project Observing	
Tue, Nov 8	Statistics and Error Analysis	Project Observing	
Thu, Nov 10	Lab Exercise 8: Statistics	Project Observing	
Tue, Nov 15	Radio Astronomy	Project Data Reduction in Lab	
Thu, Nov 17	Project Data Reduction in Lab	Project Data Reduction in Lab	Final Lab Notebook/Log Due Friday 11/18 by 5:00pm
Tue, Nov	High Energy and Non-EM Astronomy	No Observing	

22			
Thu, Nov 24	THANKSGIVING	No Observing	
Tue, Nov 29	TBD	Project Data Reduction in Lab	
Thu, Dec 1	Final Presentations	Project Data Reduction in Lab	
Tue, Dec 6	Final Presentations	No Observing	Project Write-Up Due
Tue, Dec 13th	Cummulative Final Exam		

ACADEMIC INTEGRITY

I support the TTU Code of Student conduct. Essentially, it states:

> *It is the aim of the faculty of Texas Tech University to foster a spirit of complete honesty and high standard of integrity. The attempt of students to present as their own any work not honestly performed is regarded by the faculty and administration as a most serious offense and renders the offenders liable to serious consequences, possibly suspension.*

For the remainder of the code, see: http://www.depts.ttu.edu/opmanual/OP34.12.pdf

RELIGIOUS HOLIDAYS

Texas law requires institutions of higher education to excuse a student from attending classes or other required activities, including examinations, for the observance of a religious holiday. The student shall also be excused for time necessary to travel. An institution may not penalize the student for the absence and allows for the student to take an exam or complete an assignment from which the student is excused. While no prior notification of the instructor is required, OP 34.19 indicates that a student who intends to observe a religious holiday should make that intention known to the instructor prior to the absence. The student should make up any missed work. For more information, please visit: https://www.depts.ttu.edu/opmanual/OP34.19.pdf

DISABILITY SERVICES

Any student who, because of a disability, may require special arrangements in order to meet the course requirements should contact the instructor as soon as possible to make any necessary arrangements. Students should present appropriate verification from Student Disability Services during the instructor's office hours. Please note: instructors are not allowed to provide classroom accommodations to a student until appropriate verification from Student Disability Services has been provided. For additional information, please contact Student Disability Services in 335 West Hall or call **806.742.2405**.
http://www.depts.ttu.edu/opmanual/OP34.22.pdf

UNIVERSITY COUNSELING AND RESOURCES FOR DISCRIMINATION, HARASSMENT, AND SEXUAL VIOLENCE

The university experience can be a time of substantial growth for students, filled with changes, challenges and new decisions. Few students move through this time without some personal turbulence, and many experience periods of trauma, crisis, stress, and confusion. The Student Counseling Center staff is available to help students with any problems they may be experiencing. For more information, please visit: http://www.depts.ttu.edu/scc/. Texas Tech University is committed to providing and strengthening an educational, working, and living environment where students, faculty, staff, and visitors are free from gender and/or sex discrimination of any kind. Sexual assault, discrimination, harassment, and other Title IX violations are not tolerated by the University. Report any incidents to the Office for Student Rights & Resolution, **(806)-742-SAFE (7233)** or file a report online at titleix.ttu.edu/students. Faculty and staff members at TTU are committed to connecting you to resources on campus. Some of these available resources are:

- **TTU Student Counseling Center**, **806-742-3674**, https://www.depts.ttu.edu/scc/ (Provides confidential support on campus.)
- **TTU Student Counseling Center 24-hour Helpline**, **806-742-5555**, (Assists students who are experiencing a mental health or interpersonal violence crisis. If you call the helpline, you will speak with a mental health counselor.)
- **Voice of Hope Lubbock Rape Crisis Center**, **806-763-7273**, http://voiceofhopelubbock.org (24-hour hotline that provides support for survivors of sexual violence.)
- **The Risk, Intervention, Safety and Education (RISE) Office**, **806-742-2110**, http://rise.ttu.edu (Provides a range of resources and support options focused on prevention education and student wellness.)
- **Texas Tech Police Department**, **806-742-3931**, http://www.depts.ttu.edu/ttpd/ (To report criminal activity that occurs on or near Texas Tech campus.)

SECURITY

It is very important that you familiarize yourself with the emergency procedures for evacuation, fire, flood, medical, violence and workplace threats, and tornado. You can find these procedures at the following link: http://www.depts.ttu.edu/communications/emergency/procedures.php In the case of an emergency, if at all possible, the class should shelter in place. If the building that the class is in is affected, follow the evacuation procedures for the building. After evacuation, seek shelter at a predetermined rendezvous location. When clear of the building please continue away from the building and meet class Instructor at Memorial Circle.

EMERGENCY NOTIFICATIONS AND ALERTS

TechAlert! is the principal method that the University uses to communicate emergency situations and class cancellations or delays. If you have not already done so this semester, update cell phone, home phone or text message information at: https://appserv.itts.ttu.edu/EmergencyAlert/